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Central Eurasia: Space

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Declining Value of Cosmonaut Pay Highlighted

937Q0130A Moscow TRUD in Russian 30 Apr 93 p 2

[Article by Vitaliy Golovachev, TRUD political reviewer: "You Must Pay, Space Hero. Why the Very Difficult and Risky Work of Cosmonauts is So Poorly Rewarded"]

[Text] The cosmonaut profession, only recently the most popular and extremely well paid, today in many respects has not only lost its former luster, but also material stimuli. The high risk, extraordinary responsibility and complexity of the work beyond the limits of the planet, none of this has changed. However, the real pay for courage and the enormous output of energies in the black abyss of space has dropped substantially. One of the renowned cosmonauts, returning from a half-year flight, acknowledged with bitterness that the money received did not suffice even for the purchase of a garage—a long-held dream of the hero...

You say that a garage does not bring happiness? But the unfair, reduced pay may have the result that no one will fly into orbit. (Incidentally, the question of the possibility of a strike already has arisen once before among some of the cosmonauts). Like everyone, I was ashamed when recently in a television report from the Flight Control Center the sum of the compensation for the cosmonauts for emerging into open space three times was announced. The money by the former yardstick was scarcely small—a million rubles, or 330 000 rubles for each entry into open space. But today these 330 000 rubles are less than the monthly wage of some factory director.

What's more, the cosmonauts may by no means receive this full amount. In the contract signed between the employer (Energiya NPO) and the crew there is provision for a system of penalties. If the cosmonauts allow some negligence or violate the instructions, penalty points will immediately be assigned which will reduce the total compensation. There, above the planet, the crew members must be constantly on the alert in order to avoid these cursed penalty points and not to violate the instructions...

And now let's recall the nature of the work which Gennadiy Manakov and Aleksandr Poleshchuk had to perform during emergence into open space. They had a complex task: first, to disassemble the electric drive of the solar cells on the outer surface of the "Kristall" (one of the modules). Then the commander together with the removed assembly had to brace himself on the end of a load-bearing telescopic boom and move astride it in space for 20 meters, "jumping over" to the another module, the "Kvant." And, finally, the final stage was the installation of the electric drive on the "Kvant" beam.

The crew acted strictly in conformity to plan. The boom was controlled by the ship's engineer. The commander carried the electric drive to the "Kvant" and mounted it there. The unwieldy spacesuits of the rigid type and the inflated gloves made it difficult to work. Heavy work in space continued for 5 ½ hours. During this time Manakov and Poleshchuk flew around the planet almost four times. On the daytime side the sun bore down mercilessly and the cooling system of the spacesuits operated at full capacity, otherwise the temperature would rise to a hundred degrees. But on the nighttime side, in the Earth's shadow, there was fierce cold, more bitter than in Antarctica. The spacesuit once again afforded protection against it.

Even on the ground during training in the hydrolaboratory, where emergence into space is simulated, the crew members lose from 1 ½ to 2 kg in weight—so great are the physical loads. But in space emotional stress, a risk factor, is added.

It is true that designers are striving to do everything possible in order to ensure cosmonaut safety, but the risk remains. And there is plenty. For example, the emergency system of the "rigid" spacesuit is rated for 25 minutes of operation. And if, let's assume (and God forbid) that two emergency factors arise, such as the telescopic boom on which the cosmonaut "leaps" from module to module malfunctions, and damage also occurs in the spacesuit, dictating immediate return to the station, the commander would not be able to move from the "Kvant" surface to the hatch in 25 minutes... I do not mention this in order to incite alarm, but once again to demonstrate the danger of man's work in a medium foreign to him where he always must be ready for "surprises."

An unpleasant "surprise" occurred during the time of emergence of Manakov and Poleshchuk into open space. When all the work was completed, when the electric drive was secured in its new place and the cosmonauts were preparing to return to the station, it was suddenly discovered that one of the two levers by means of which the ship's engineer controlled the telescopic boom used in the "transfer" of the commander to the "Kvant" and back, flew off somewhere. Where this lever "floated off" and how it separated from the boom was not very understandable. Thank heaven that it "floated off" when the commander was already near the hatch. Incidentally, there were no spare levers on the station. Now it will be necessary to await the arrival of a supply ship from the Earth which will deliver this replacement part. Thus, two other walks into space were postponed to a later time...

Such is the nature of "quiet" work in space. How much will the generous directors of the Energiya NPO pay for this work? How many penalty points are being assessed? Will the lever which floated away be charged to the cosmonauts or to the designers and builders? Or, possibly, when Manakov and Poleshchuk return to Earth will it be found that they are even in debt?

Incidentally, how come the cosmonaut detachment with respect to financial matters is always playing a losing game? Let's say that for commercial space flights of

foreign specialists a fairly good payment in foreign exchange is received: from 12 to 15 million dollars. But these millions of dollars will go one place or another, primarily to the Energiya NPO, and the cosmonauts will not receive one cent. This despite the fact that without their active participation neither the training of their foreign colleagues for flight nor their work on the station would be possible. I understand that foreign exchange is necessary for the big "space" bosses and for the development of "business," and, indeed, in our day it is in general highly valued. But after all there are still elementary norms of ethics and decency.

I do not know how much will in the end be handed over to the cosmonauts from these 330 000 rubles after the withholding of taxes and other deductions. But one thing is clear: in July, after their return to Earth, Manakov and Poleshchuk will scarcely have enough money received from their emergence into open space for the purchase of even a first-class TV set or refrigerator. The conditions of the contract are kept in deep secrecy by the Energiya NPO directors. And if I am in error about something, I would be happy to return to this theme. However, according to available information it appears that in conversion to foreign exchange the cosmonauts earned a maximum (ignoring taxes and penalties) of about 400 dollars. The average monthly wage of a worker in the United States, Japan or West Germany is many times greater than this sum. In my opinion it is not simply unfair, but it is outrageous to set such a wage for our space aces...

Today cosmonauts are not encountered in Red Square and are not carried around in black "Chaykas." They do not go into space for the sake of glory. And therefore I would all the more like to ask the directors of the Energiya NPO and the Russian Space Agency: is it admissible to "exploit" the enthusiasm of people so dedicated to their work?

'Auroral Trigger' Experiment. 2. Generation of Wave Electrical Fields and Initial Burst of Electron Stream

937Q0139A Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 2, Mar-Apr 93 (manuscript received 18 Aug 92) pp 3-10

[Article by M. G. Deminov, Yu. V. Dumin, A. N. Omelchenko, Yu. A. Romanovskiy, V. M. Feygin, O. S. Fominov and A. V. Tsema; UDC 551.510.536]

[Abstract] This is the second part of a study initiated in this journal in Vol 31 No 1, p 65, 1993. The results of measurements and analysis of wave electric fields in the ELF-VLF ranges and electron streams, observed in a rocket experiment with the injection of plasma-forming compounds in the high-latitude ionosphere on 17 September 1990, are presented. The initial intensive burst of electrons with W about 1 keV, associated with the injection of a plasma cloud, is evidently supported by electrostatic ionocyclotron turbulence near the plasma cloud below the altitude of the F2 layer maximum. This turbulence is the result of a field-alined current of an Alfven wave which is generated in the initial stage of cloud escape. The great magnitude of this field-alined current, transverse electric field and stream of accelerated electrons in the initial stage of cloud escape are the principal reasons for a strong increase in the amplitude of the wave electric fields in virtually the entire range of measured frequencies. It is demonstrated that the background parameters of the ionosphere ensured the existence of a lower hybrid resonance waveguide below the altitude of the F2 layer maximum and above the E layer maximum at frequencies near 4-5 kHz. Electron streams $W \leq 1$ keV are the principal sources of the local generation of waves carried by this waveguide. Figures 2; references 8: 6 Russian, 2 Western.

Research on Artificial Formations in Ionosphere by Radiophysical Methods. 1. Artificial Ion Clouds

937Q0139B Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 2, Mar-Apr 93 (manuscript received 18 Aug 92) pp 11-31

[Article by V. A. Alebastrov, N. F. Blagoveshchenskaya, V. P. Ivanov, V. N. Zyuzin, A. M. Kulikov, B. Ye. Lyannoy, R. I. Moysya, S. A. Namazov, A. M. Nasyrov, Yu. A. Romanovskiy and V. A. Strekalov; UDC 551.510.536]

[Abstract] A study was made of the physical processes transpiring during the generation of artificial ion clouds and the modifications of the ionosphere associated with them. Observations were made over the Kapustin Yar test site using MR-12 and MR-20 rockets with the injection of compounds containing Ba and Cs, resulting in the formation of ion clouds at altitudes 140-190 km. A figure shows the geometry of the experiment (the radiation and reception points included Kropotkin, Nikolayev, Kiev, Teheran, Diego Garcia, Almaty, Novocherkassk, Kazan, Tomsk, St. Petersburg and Astrakhan). A table gives the technical specifications of the radiophysical apparatus used. Information is given on the basis of many-sided studies of the disturbed ionosphere using the following radiophysical methods: vertical, slant and slant-backscattering sounding with an analysis of Doppler effects, this broad ensemble of observation methods considerably broadening the possibilities for investigating artificial ionized clouds and the modified ionosphere with respect to both diagnosis of the general spatial-temporal evolution of these clouds and study of complex processes of interaction between such clouds and the ionosphere. Detailed results are given. Figures 15; references 24: 23 Russian, 1 Western.

Ionospheric Effects Accompanying Injection of High-Velocity Cumulative Air-Plasma Jet

937Q0139C Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 2, Mar-Apr 93 (manuscript received 18 Aug 92) pp 32-42

[Article by M. B. Belotserkovskiy, A. V. Gurvich, A. M. Yevtushevskiy, Yu. N. Kiselev, G. P. Milinevskiy, Yu. A. Romanovskiy, B. D. Khristoforov and V. M. Feygin; UDC 551.510.536]

[Abstract] The possibility of using a new source of artificial disturbance of the ionosphere is an explosive generator of a plasma jet (EGPJ). Experiments with such a source were carried out under the "Kumulyus" program using MR-12 rockets carrying small EGPJ (the parameters of four such EGPJ are given in a table; another table gives data on five such experiments). Much background information on these observations was given in an article by V. A. Alebastrov, et al. in KOSMICH. ISSLED., Vol 31 No 1, 1993. With the injection of a cumulative plasma jet with a total mass 1-2 g a disturbed region is formed in the ionosphere at altitudes 140-150 km whose dimensions attain 2-3 km and the lifetime registered instrumentally is about 3-5 minutes. After a burst lasting up to 0.1 s a region with $N_e 5 \times 10^6$-10^8 cm^{-1} is registered which persists for 2-3 s. The relaxation of the disturbed region, occurring after 0.5-3 minutes, is described by photochemical models of the ionosphere disturbed by such a burst. The ionospheric disturbance arising with injection of the jet is characterized by the generation of intensive constant and variable electric fields, local current systems and an increase in the streams of accelerated and leaking electrons. Figures 8; references: 12 Russian.

Structure and Dynamics of Artificial Cosmosol Formations in Upper Atmosphere

937Q0139D Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 2, Mar-Apr 93 (manuscript received 18 Jun 92) pp 43-54

[Article by T. V. Buzdygar, V. V. Gaplevskaya, I. V. Dorokhova, O. F. Klyuyev and P. G. Matukhin; UDC 551.510.536]

[Abstract] A rocket experiment is described in which artificial cosmosol formations were generated under optimum twilight conditions at altitudes 120-190 km for

simulating processes of spatial-temporal evolution of dust and gas components of anthropogenic pollution of circumterrestrial space. A method for visualizing such formations is proposed. Observations were made with wide-lens, motion picture and television cameras, including with brightness amplifiers, and a spectrograph with brightness amplifier with a spectral range 4000-8000 A and a spectral resolution 5-15 A. Wide-lens cameras with a field of view 30-45° were used in registry of cloud spatial structure. Motion picture cameras without brightness amplifiers ensured cloud registry with a time resolution 0.1 s. Motion picture cameras with brightness amplifiers made possible a survey with an exposure 20-30 ms. Observations were made synchronously from two or more points separated from one another by several tens of kilometers for determining the spatial coordinates of the cloud. An optical model of a cloud of dust particles measuring up to 100 μm is described. Experimental data are given on determination of the structural and dynamic parameters of artificial cosmosol formations of different types. There was a satisfactory agreement between the measurement results and the model. Figures 7; references 9: 6 Russian, 3 Western.

Optimum Redundant Geometric Structure of Inertial Measuring Instruments on Spacecraft

937Q0139E Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 2, Mar-Apr 93 (manuscript received 21 Mar 90) pp 100-107

[Article by V. I. Golovatenko-Abramov; UDC 629.191.2:62-56]

[Abstract] The concept of creating an inertial measuring system with an optimum geometric structure is described. The problem of synthesis of an optimum redundant geometric structure of an inertial measuring system is formulated and some results of its solution are given. The advantages of use of optimum redundant geometric structures in inertial measuring systems of spacecraft are outlined. An example is given: comparison of the characteristics of the optimum structure and the corresponding characteristics of a reserved structure, that is, a configuration in which the directions of the axes are mutually orthogonal, and in addition, there are identical numbers of uniaxial measuring instruments. The use of such an optimum structure makes it possible to reduce to an absolute minimum the errors in reproducing the signal of an inertial measuring system with a fixed level of measurement errors. This is achieved without structural improvement in the parameters of uniaxial measuring instruments. The field of desirable technical applications for this theory includes gyrosystems for determining the parameters of rotational motion and groups of newtonmeters for determining linear acceleration. The use of optimum redundant structures also would be effective in the case of a platformless architecture of the inertial measuring system and in the case of use of a stabilized platform. Figure 1; references 3: 2 Russian, 1 Western.

Qualitative Research on Plane Oscillations of Magnetized Satellite in Polar Orbit

937Q0139F Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 2, Mar-Apr 93 (manuscript received 22 Mar 92) pp 120-124

[Article by R. Ch. Kazymov; UDC 629.195.1]

[Abstract] This study is centered on a qualitative analysis and elaboration of some properties of solutions of an equation for plane oscillations of a magnetized satellite in a polar orbit proposed by V. V. Beletskiy, et al. in Vrashchatelnoye dvizheniye namagnichennogo sputnika (Rotational Motion of a Magnetized Satellite), Moscow, 1985. The considered equation describes the plane motion of a satellite (solid body) relative to its center of mass moving in a circular polar orbit in which the independent variable is the argument of latitude. The Earth's magnetic field is considered dipolar and the moment of magnetic forces is considered small in comparison with the gravitational moment. The original equation is reexamined in a Hamiltonian form and after an in- depth consideration of all the complexities involved (with reference to the pertinent literature) a general solution is found (an asymptotic solution in variables also is given) and a proof is presented. Special cases are considered in the course of the presentation. Figure 1; references 10: 9 Russian, 1 Western.

Deuterium Synthesis During 24 May 1990 Solar Flare. Granat Observation of Delayed 3.3 MeV Gamma-Line Emission

937Q0138A Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 19 No 3, Mar 93 [manuscript submitted 27 Nov 92] pp 163-171

[Article by O. B. Terekhov, R. A. Syunyayev, A. V. Kuznetsov, C. Barat, R. Talon, G. Trottet, N. Vilmer, Space Research Institute, Russian Academy of Sciences, Moscow; Center for the Study of Space Emissions, Toulouse, France; Medon Observatory, France; UDC 520.6;523.985]

[Abstract] In its first year of observation, the PHEBUS instrument—an instrument carried by the high-apogee Granat observatory and designed for the study of gamma bursts in space—recorded nearly 40 solar events. Two bright events on 11 May 1990 and 24 May 1990—labelled SF900511 and SF900524, respectively—showed energies of up to 120 MeV and were induced by the same active region, n6063. Event SF900524 was accompanied by a class 1B flare in the Hα line, with coordinates of N33W78. It was associated with a bright X-ray event X9.3 from the GOES satellite catalog and with intense microwave emissions and type II and IV radiowave emissions. The 2.2 MeV gamma-line emission was the result of a $^{1}H(n,\gamma)^{2}H$ deuterium synthesis reaction. The 2.2 MeV maximum evidenced a delay of 100 sec in relation to the maxima for the 4-6 MeV and 65-120 MeV ranges. A decaying brightness flux was detected for more than 8 min after the emission maximum in the 4-6 MeV

range. The number of photons in the 2.2 MeV line during the entire flare was 345+/-6 photons/cm_2. Figures 3, references 24: 5 Russian, 19 Western.

Observation of Large Magellanic Cloud in Hard X-Ray Range. Upper Limits to Flux From Supernova 1987A

937Q0138B Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 19 No 3, Mar 93 [manuscript submitted 27 Nov 92] pp 172-180

[Article by A. V. Finogenov, M. R. Gilfanov, S. A. Grebenev, R. A. Syunyayev, Ye. M. Churazov, R. S. Kremnev, K. G. Sukhanov, N. G. Kuleshova, F. Lebrun, A. Claret, A. Goldwurm, P. Laurent, E. Jourdain, J. P. Rogues, P. Mandrou, F. Pelaez, Space Research Institute, Russian Academy of Sciences, Moscow; National Center for Space Research, Toulouse, France; Astrophysical Service of the Center for Nuclear Research, Sacle, France; Center for the Study of Space Emissions, Toulouse, France; UDC 520.6;524.722.3;524.35]

[Text] The Granat observatory's SIGMA telescope did not detect a statistically significant flux in the hard X-ray range from any of the 97 sources observed by the Einstein observatory in the soft X-ray range, with the possible exception of CAL87. The sensitivity (3σ) achieved in the course of the observations was 6×10^{37} erg/s in the 40-150 keV range (assuming a distance to the LMC of 55 kparsec. Such luminosity would be several times brighter than that of Cyg X-1, a well-known black-hole candidate. The 3σ upper limits are presented for LMC X-1 and LMC X-4. Measurements indicate the number of radioactive elements in the shell of the supernova 1987A to be limited to 2.4×10^{-3} in terms of solar mass for ^{22}Na and 2.3×10^{-2} for ^{44}Ti. Figures 4, references 12: 5 Russian, 7 Western.

Detection of Periodic Gravity-Wave Signals Emanating From Source PSR 0021-72A From Modulation of Optical Solar Radiation

937Q0121A Moscow DOKLADY AKADEMII NAUK in Russian Vol 329 No 2, Mar 93 [manuscript submitted 16 Nov 92] pp 151-153

[Article by Yu. M. Ayvazyan, A. B. Balakin, Russian Academy of Sciences Corresponding Member G. V. Kisunko, Z. G. Murzakhanov, I. A. Rokos, Department of Work Problems, Russian Academy of Sciences, Moscow; Kazan State University; Scientific-Production Association VNIIFTRI, Mendeleyevo, Moscow Oblast; UDC 523.034.43]

[Abstract] The concept developed for the interferometric detection of periodic gravity waves coming from relativistic binary pulsars via the modulation of optical radiation has made it possible to take a new look at the inclusion of astrophysical sources of electromagnetic radiation in gravity-wave experiments. The high resolution- and frequency-related predictability of gravity-wave signals from periodic sources, however, is underused, and the technical advances made in terms of the identification of weak periodic signals have gone unused. The researchers here study the possibility of registering the phase modulation of the Sun's optical radiation, as well as that of the stars of the spherical cluster 47 TUCANAE. Such modulation is caused by the periodic gravity waves from PSR 0021-72A, a binary source located inside the cluster. The interest in solar light as a target of gravity-wave research stems from the fact that the half-period of gravity waves from PSR 0021-72A ($1/2T_g$ = 481.75 s) is close to the time of propagation of light between the Sun and the Earth (499 s). The wavelength of the gravity-wave source PSR 1913-16, which is the closest source in that regard, differs by more than an order of magnitude from what is needed. That fact that the distance between the Sun and the Earth is commensurate with the half-wavelength sets the stage for the unique possibility of matched detection of a gravity-wave signal with an Earth-Sun gravity-wave antenna with optical survey of information. Figures 2, references 10: 5 Russian, 5 Western.

'Active Experiments and Anthropogenic Effects in the Ionosphere' Program: Organization, Hardware and Procedural Support, and Basic Research Results

937Q0107A Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 1, Jan-Feb 93 [manuscript submitted 18 Aug 92] pp 3-25

[Article by S. I. Avdyushin, N. V. Vetchinkin, S. I. Kozlov, N. N. Petrov, Yu. A. Romanovskiy; UDC 551.510.536]

[Abstract] In light of the fairly wide use made of active experiments in the study of near-Earth space, the authors here chose to present an overview of the state of the art of hardware and techniques used in the artificial modification of the ionosphere in the period 1980-1991. (Other articles in the same issue of the journal target specific programs surveyed here.) The survey was led by the Fedorov Institute of Applied Geophysics and was based on more than 40 experiments involving MR-12 and MR-20 rockets and satellites, which were employed to study the injection of plasma-forming compounds, gas-dispersion components, various plasma jets, plasma blobs, barium vapors, and hf radio waves. The experiments studied included the following programs: "Artificial Clouds," "Aelita," "Ariel," "Cumulus," "CRRES," "Meteor," "Spolokh" [Northern Lights], and "Nagrev" [Heatup]. It was found that the charge-produced injection of a gas-dispersion and plasma-forming mixture at altitudes under 200 km are accompanied by the appearance of a compacted zone with an elevated concentration of neutral gas and plasma moving at 1-1.7 km/s. The gas decelerates within 1-3 s and is accompanied by the separation of the gas and dispersive components, which leads to a one- to twofold increase in plasma density at the front of the expanding cloud and a three- to tenfold decrease in the concentration of the primary neutral component behind the front. Electrodynamic processes at the initial stage of dispersal consist of the generation

of a polarization electrical-field pulse at the front and the disturbance of the constant field in the cloud. The magnetic field grows slightly at the cloud periphery, whereas a magnetic field "cavern" forms inside. That indicates the generation of a local current system that emits alfven waves. Radiophysics studies point to the existence of periodic plasma structures after injection. Fine-structure studies revealed new features: high-altitude threshold for the development of instabilities; fast "catastrophic" nature of the development of irregularities; appearance of "superthin" structures, as well as large-scale irregularities dozens of kilometers across. The satellite studies recorded phenomena indicating a more efficient formation of ions based on alfven ionization; the generation of intense ion beams along geomagnetic field lines of force ($V > 4$ km/s); and the formation of large, long-lived plasma structures. Optical studies indicate that chemically active components injected at F2 altitudes can enter into photochemical reactions with ionospheric components. Figures 2, references 78: 46 Russian, 32 Western.

Artificial Modification of the Ionosphere in Active Experiments and as the Result of Anthropogenic Effects

937Q0107B Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 1, Jan-Feb 93 [manuscript submitted 18 Aug 92] pp 26-40

[Article by S. I. Kozlov, Yu. A. Romanovskiy; UDC 551.510.536]

[Abstract] Results are presented of research involving artificial modification of the ionosphere by active experiments and by anthropogenic effects produced by rocket launches and the operation of radio equipment. In terms of gas-dynamic processes, studies of local modification produced by the injection of plasma-forming components indicated that the injection of the mixture forms a neutral cloud from which, 2-4 s later, a semispherical formation of disperse particles forms that moves uninhibited for 10-15 s. Electrodynamic effects are observed: modification of the magnetic field near the injection region; generation of electrical fields; formation of local current system; development of various plasma instabilities; and generation of MHD waves. The dramatic increase in electron density and temperature that results from the injection of the mixture changes ion composition and causes the neutral and ionizing components to glow. The principal feature of the diffusional evolution of artificial ion clouds consists in the lengthy existence of such clouds in the ionosphere (up to 14 hours). Stratification is typical. The researchers found a pronounced altitude boundary for the stratification, at 150-160 km. Irregularities occur at $t < 30$ s in a broad range of probing frequencies. Small-scale irregularities are recorded over the life of an artificial ion cloud. At higher altitudes (400-500 km), the fine structure is seen in only the densest part of the cloud. Plasma injection studies lead to the conclusions that, under 200 km altitude, deceleration of plasma jets and blobs occurs at $t < 1$ s, 1-5 km from the point of injection. Interaction of plasma and ionosphere produces various plasma instabilities that manifest themselves as intense lf oscillations. Injection pitch-angle largely determines plasma effect. The plasma structure that is formed consists of injected ions and products of their interaction with the ionosphere. At 130-150 km, plasma irregularities can be 10 meters long. Plasma injection results in the generation of electrical fields and intense plasma fluctuations, increases electron flux, and changes ion composition. Nonlocal effects produced by injection of plasma or plasma-forming components include generation of wave phenomena in the upper atmosphere and ionospheric disturbances; stimulation of MHD waves; precipitation of trapped particles from the Earth's radiation belts; generation of high-velocity plasma fluxes along lines of force; formation of ionosphere-plasmasphere irregularities; generation of the auroral trigger and Rayleigh-Taylor irregularities; and stimulation of outer ionosphere phenomena. Launch and radio wave effects are also examined. Figures 9, references 35: 23 Russian, 12 Western.

Optical Observations of Artificial Clouds in the Upper Atmosphere

937Q0107C Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 1, Jan-Feb 93 [manuscript submitted 18 Aug 92] pp 41-53

[Article by G. P. Milinevskiy, Yu. A. Romanovskiy, V. V. Alpatov, Yu. Ye. Belikov, M. B. Belotserkovskiy, Z. I. Gritsay, A. V. Gurvich, A. M. Yevtushevskiy, V. A. Kravchenko, S. Sh. Nikolayshvili, Yu. V. Platov, V. A. Savchenko, S. A. Chernous; UDC 551.510.536]

[Abstract] Optical observations of the artificial clouds formed by 30 rocket experiments and certain satellite experiments in 1980-1991 are analyzed. A so-called multipositional optical diagnostic complex was created by the Fedorov Institute of Applied Geophysics and the Shevchenko Kiev University for use in the observations. Equipment was borrowed at times from the Polar Geophysical Institute and the Institute of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation in order to expand the scope of the observations. The complex included television and photo recording equipment, spectrophotometers, and spectrographs. Among the special features noted in the development of artificial clouds and in their interaction with solar radiation is that radiational cooling of an injected pyrotechnic mixture occurs rapidly ($t < 1$ s). The researchers also recorded emission lines corresponding to the D-P transition of barium atoms and indicating a large D population in the injected mixture. That lowers photoionization time to 20-25 s. Relaxation of the nonequilibrium distribution appears to take place over a period of $t < 3$ s. Efficient oxidation of Ba atoms below 160 km results in the rapid interaction of Ba atoms and oxygen and in weak photoionization of the Ba atoms. The change noted in barium ion line glow stems from photoionization in the early stage and from cloud expansion after that. Figures 9, references 39: 20 Russian, 19 Western.

Auroral Trigger Experiment. I. Generation of Electrical Fields and Particle Fluxes by Injection of Plasma-Forming Compounds Into the High-Latitude Ionosphere

937Q0107D Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 1, Jan-Feb 93 [manuscript submitted 18 Aug 92] pp 54-62

[Article by V. Yu. Gaydukov, M. G. Deminov, Yu. V. Dumin, A. N. Omelchenko, Yu. A. Romanovskiy, V. M. Feygin; UDC 551.510.536]

[Abstract] The results for an experiment conducted on 17 September 1990 at 19.95 LT at 67.78°N, 00.25°W (MacIlwain parameter, L = 6, 15). A rocket launched from an r/v released measurement equipment and a container with a pyrogenerator containing 14 kg of plasma-forming mixture. The measurement equipment consisted of ion and neutral mass-spectrometers; a spectral probe that measured quasiconstant electrical field and variable electrical-field component in 10 frequency channels (from 35 Hz to 18 kHz); an electron spectrometer with two monitoring channels at 1 keV and 5 keV; a Geiger counter measuring flux of charged particles with energies over 40 keV; and a two-component magnetic-field sensor. The container with the mixture was released at 105 seconds into the flight, with a relative velocity of 8 m/s^{-1}. The pyrogenerator was activated at 156 s, when the container was approximately 400 m from the rocket. Altitude at that point in time was 191 km. The pyrogenerator was in operation for 0.1-0.2 s. Launch azimuth was 320° (northwest), and rocket velocity was 133 m/s^{-1}. The researchers found that injection of the compounds produced a pulsing precipitation of electrons with energies of about 1 keV. That was due to background conditions and to the experimental conditions, which produced an intense alfven wave. The parameters of the wave are estimated to be sufficient for dissipation of a considerable portion of the wave's energy at the upper boundary of the ionospheric alfven resonator (IAR) and the turbulent boundary layer (TBL). Electrons are accelerated by the longitudinal electrical field of the TBL to energies of about 1 keV. The matchup of the basic frequency of the electron pulsations and the natural frequency of the IAR is the experimental basis for substorm development mechanism in the precipitation of electrons. Figures 2, references 13: 7 Russian, 6 Western.

Equatorial Trigger Experiment: Stimulation of Development of Plasma Instabilities and Irregularities in Equatorial Ionosphere

937Q0107E Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 1, Jan-Feb 93 [manuscript submitted 18 Aug 92] pp 63-70

[Article by V. Yu. Gaydukov [deceased], S. A. Namazov, M. A. Nikitin, Yu. A. Romanovskiy; UDC 551.510.536]

[Abstract] A distinguishing feature of the equatorial ionosphere is the existence of ionization bubbles along the magnetic field, i.e., large-scale irregularities with lower electron densities. The bubbles are usually explained with theoretical ideas on the development of the Rayleigh-Taylor instability in the post-sunset hours at the base of the equatorial F layer, where there is a sharp drop in N_e as the F layer drifts upward. The triggering of the Rayleigh-Taylor instability shows up in small seeding disturbances that are several percent of the background values of N_e, which leads ultimately to the formation of large-scale irregularities with N_e diminished to three orders of magnitude. The Equatorial Trigger program called for a series of active experiments verifying the mechanisms of the triggering of the instability and of irregularities in the equatorial ionosphere. In presenting the results of experiments involving the wave mechanism of the triggering of the instability and spread F, the researchers observed the following about the ionospheric response to the injection of a plasma-forming substance. The injection produced two types of disturbance. One showed up at various altitudes with a time shift that increased as the probing frequency grew. It was characterized by a wavelike change in F against the backdrop of an overall change linked to the regular drift of ionization. Another type of disturbance appeared right after injection, near the F layer maximum. The wavelike disturbances of F at f = 6.4 MHz were accompanied by an widening and blurring of the Doppler spectrum to +/-0.5 Hz of the center frequency. Blurred Dopplers after passage of the wavelike disturbance were recorded at f = 10.9 MHz. The natural spread F effect was recorded for more than an hour after the passage of the artificial wavelike disturbance and took up the entire depth of the ionosphere. The researchers concluded that the injection of a plasma-forming component at an altitude of about 200 km is accompanied by the generation of a wavelike disturbance that propagates to the altitude of the F layer maximum (430 km) and induces the formation of plasma irregularities that, in turn, lead to the widening of the Doppler spectra of the reflected signal and to the spread F. Figures 4, references 22: 14 Russian, 8 Western.

Preliminary Results of Research on Artificial Formations in the Ionosphere in CRRES Experiments

937Q0107F Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 1, Jan-Feb 93 [manuscript submitted 18 Aug 92] pp 71-83

[Article by S. I. Avdyushin, O. F. Klyuyev, G. P. Milinevskiy, S. A. Namazov, V. N. Orayevskiy, Kh. Peres, Yu. I. Portnyagin, Yu. A. Romanovskiy, Yu. Ya. Ruzhin; UDC 551.510.536]

[Abstract] Results are presented for five optical-radiophysics studies of artificial clouds created in the CRRES project in the ionosphere over the Caribbean Sea. The artificial formations were produced at altitudes of 410-507 km in the region of the morning terminator at solar submersion angles of 4-12°. Two types of generators were used in the experiments: one that injected 3.3 kg barium vapor, a second that injected 12 kg barium

vapor. The observations of the clouds (neutral and ionized formations in the F region)—airborne optical observations over the eastern part of Cuba between 74.5° and 76.5° W long and optical and radiophysics observations and measurements made aboard the r/v Professor Zubov in the Caribbean—yielded the following results. The neutral Ba cloud moved along the satellite orbit at 8-9 km/s and expanded at a rate of 1.5-1.7 km/s. The movement stopped after 20-30 s, but the cloud continued to expand for 10-20 s. The evolution cannot be explained with hydrodynamic models and must be modelled on a kinetic approach. The color dynamics of the cloud can be explained with the ideas advanced by Belikov *et al.* (KOSMICHESKIYE ISSLEDOVANIYA Vol 31 No 1, Jan-Feb 93 pp 108-114). Initially, the ion cloud evidenced the intense generation of ions 15-18 km from the point of injection, with a conical structure extending along the satellite orbit beyond the neutral cloud. Across the geomagnetic field, the initial ion cloud spanned 250-300 km. An ion flux stretched from the cloud along geomagnetic field force lines, "tracing" the geomagnetic field. The final stage of evolution of the cloud showed various scales of irregularities that went from several kilometers in the dense, leading part of the cloud to several dozens of kilometers in the diffuse tail. Ion-probe and Doppler techniques of observation confirmed the plasma irregularities in the ionosphere with $N_e = 1.5 \times 10^6$ cm and lifetimes of more than four hours. Spectral observations point to the formation of a considerable amount of Ba ions 1-5 s after injection at a distance of 15 km from the point of injection. Figures 11, references 9: 8 Russian, 1 Western.

Satellite Studies of Topside Ionosphere Disturbances When the Ionospheric F Region Is Being Irradiated With Powerful HF Radio Waves

937Q0107G Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 1, Jan-Feb 93 [manuscript submitted 18 Aug 92] pp 84-92

[Article by V. M. Kostin, Yu. A. Romanovskiy, V. M. Chmyrev, V. M. Sinelnikov, V. V. Afonin, N. D. Borisov, V. A. Zyuzin, N. V. Isayev, G. P. Komrakov, Yu. M. Mikhaylov, O. Ye. Ovcharenko, M. S. Petrov, S. A. Namazov, V. V. Selegey, Ya. P. Sobolev, Ye. P. Trushkina; UDC 551.510.536]

[Abstract] Until recently, satellite observations of the topside ionosphere had been of only low-frequency emissions associated with the modulation of the auroral current jet by powerful hf radio waves. But comprehensive research is needed that includes the study of the scale of the disturbed zone at various altitudes in the ionosphere, typical parameters of irregularities in concentration and electron temperature, and disturbances of low-frequency electrical and magnetic fields. In the period of February-May 1991, a special program was executed in which the Kosmos-1809 and Interkosmos-24 satellites made observations of the effects produced on the topside ionosphere by a high-frequency emitter near Nizhniy Novogorod that operated at frequencies of 4785 kHz, 5828 kHz, 7815 kHz, and 9310 kHz and a similar emitter near Moscow that operated at 1350 kHz. The waves were generally of ordinary polarization. Radiating power was 300-500 MW. Only the Kosmos-1809 results are presented here. Large-scale irregularities of plasma concentration at altitudes of 150-500 km were studied with radiooccultation. The researchers found that the hf radio waves targeted at the F region resulted in correlated disturbances of plasma, E-field constants, and VLF-ELF emissions of various spatial scales. The primary types of disturbances were also recorded in regions geomagnetically linked with the F region. Regions with disturbances on scales of up to 1000 km demonstrated elevated T_e values, N_e irregularities, E-field variations, VLF-ELF modifications, and scintillations of satellite radio beacon signals. Regions with mid-scale disturbances were formed in the areas targeted by the radiowave emissions and in linked regions. Small-scale disturbances were recorded in the targeted area and linked regions on the basis of anomalous diffuse whistlers and onboard measurements of N_e and T_e. Figures 6, references 8: 5 Russian, 3 Western.

Optical Phenomena in Near-Earth Space Resulting From Operation of Rocket and Satellite Propulsion Systems. 1. Ground and Satellite Observations of Artificial Formations Associated With Rocket Launches

937Q0107H Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 1, Jan-Feb 93 [manuscript submitted 18 Aug 92] pp 93-100

[Article by N. V. Vetchinkin, I. V. Granitskiy, Yu. V. Platov, A. I. Sheykhet; UDC 551.510.536]

[Abstract] The launches of heavy rockets and the operation of propulsion systems of spacecraft release gas, plasma, and disperse particles into near-Earth space at various altitudes. The formations that result from such releases scatter solar radiation or induce a chemical-reaction glow, either of which can produce unusual optical phenomena. Although much has been written about the effects of space hardware, little attention has been devoted to a description of the artificial formations consisting of disperse particles. The researchers here present some of the results of optical observations of such artificial formations. The ground observations were made at twilight, when the observation post was in the Earth's shadow and the artificial formation was above the Earth's shadow. Satellites observations were made with the UV telescope of the Astron astrophysical satellite. Sample photographs are presented of the artificial formation produced by the 27 August 1982 launch of a Molniya satellite by a Soyuz launch vehicle. Also proffered are graphs based on Astron observations of the 3 February 1984 launch of the U.S. Space Shuttle. Analysis of the observations indicate that the rate of expansion of artificial-formation components above an altitude of 100 km is 1-2 km/s. The side-to-side dimensions of such formations can reach 1,000 km across, with a minimum time of existence of 1-6 hours. Artificial formations have

spatial irregularities ranging in size from a few kilometers to dozens of kilometers. The brightness of a formation can reach 0.1 percent of a full moon. Last, such formations have scattering properties in the UV range. Figures 6, references 10: 6 Russian, 4 Western.

Color Diagnostics of Artificial Clouds in Near-Earth Space

937Q0107I Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 1, Jan-Feb 93 [manuscript submitted 18 Aug 92] pp 108-114

[Article by Yu. Ye. Belikov, A. V. Gurvich, S. Sh. Nikolayshvili; UDC 551.510.536]

[Abstract] Optical observations and image recording of artificial illuminated clouds in near-Earth space are usually done with black-and-white television gear and cameras, which results in the loss of information concerning the physical and optical processes in clouds that is based on the cloud coloring. The coloring changes especially intensely and rapidly in the initial stage of cloud evolution, when the cloud is optically dense. Although color photos of such clouds do exist in the literature, little effort has been made to interpret them or subject them to physical analysis. The researchers here chose to analyze the processes that produce the cloud coloring and to study the link between cloud coloring, on the one hand, and cloud parameters and observation features, on the other. Using a model of the resonance scattering of solar radiation by a cloud of neutral barium, they produced quantitative estimates of the parameters attending the glow of an optically dense cloud in various spectral lines. The estimates point to a substantial number of relationships between the intensity of radiation and cloud color, on the one hand, and optical thickness of the cloud and angle of observation, on the other. Those relationships are quite pronounced when the optical thickness is great ($\tau > 5$) in the initial stage of evolution. Model data on the color distribution in the picture plane of the cloud are in good agreement with the results of observations of barium clouds in the CRRES project. The researchers suggest that conclusions about cloud structure and presence of ions can be draw from the color distribution features. Figures 3, references 12: 5 Russian, 7 Western.

Glow and Ionization of Barium Clouds Produced by Suprathermal Electrons in Active Experiments

937Q0107J Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 1, Jan-Feb 93 [manuscript submitted 18 Aug 92] pp 115-120

[Article by I. A. Grebnev, A. V. Gurvich, G. P. Milinevskiy, S. Sh. Nikolayshvili; UDC 551.510.536]

[Abstract] The kinetics of the excitation and ionization of barium atoms by suprathermal electrons formed when a barium cloud is exposed to powerful hf radio waves or as a result of alfven ionization are examined. The researchers calculate the excitation of the atoms and ions by electrons with energies of more than 30 eV and by solar UV radiation. BaI and BaII glow estimates are made. Calculations for the process of alfven ionization are compared with observations of barium-cloud spectra from a satellite experiment involving barium injection. The researchers find that, in the absence of the ionizing radiation of the Sun, the heatup of the ionosphere by powerful radio waves can lead to the excitation of the glow of a barium cloud, with a glow intensity at 553.5 nm of up to 50 rayleigh. Experimental data and model estimates show that in the zone of anomalous ionization, the processes of excitation and ionization of barium take place primarily as a result of suprathermal electrons. Intense excitation and ionization of barium atoms comparable to the effects produced by solar radiation take place in that same zone over a period of $t < 0.2$ s. Figures 2, references 15: 7 Russian, 8 Western.

Optical Tomography of Artificial Formations in Near-Earth Space

937Q0107K Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 31 No 1, Jan-Feb 93 [manuscript submitted 18 Aug 92] pp 121-134

[Article by V. V. Alpatov, G. G. Levin, V. V. Pikalov, Yu. A. Romanovskiy; UDC 551.510.536]

[Abstract] Artificial clouds are widely used as tracers of dynamic processes and irregular structures of ionospheric and magnetospheric plasma. Further improvement of the technique requires that the internal structure of the cloud be known, i.e., that the structure be reconstructed. For that, computerized reconstructive tomography can be quite effective. In addition, computerized reconstructive tomography offers the advantage of making it possible to study the internal physical-chemical and dynamic processes by examining the distribution of glow intensity. The researchers here use a model simulating an artificial cloud to examine the bases of optical tomography and some of the key aspects of its application. They find that the maximum accuracy associated with the reconstruction of internal structure (20-45 percent) can be achieved even with a relatively small number of observation angles (3-5) if noise levels are low and the most informative projections are chosen. They confirm the effectiveness of optical tomography based on three observation points via the reconstruction of the internal structure of an actual cloud at 170 km altitude. Figures 6, references 26: 19 Russian, 7 Western.

Aimable Space-Based Survey

937Q0135A Moscow OTECHESTVENNAYA GEOLOGIYA in Russian No 9, Sep 92 [manuscript submitted 20 May 91] pp 48-56

[Article by N. S. Ramm, N. V. Mezhelovskiy, V. Ye. Gendler, I. G. Maltseva, A. K. Rynskaya, V. V. Shvarev, Interregional Geologic Cartography Center GEOKART; UDC 528.71.1(202)]

[Abstract] A new high-resolution satellite-based scanning-survey technique is examined—aimable survey. The technique enables reliable scanning of the Earth's surface in any season as well as in weather-related emergencies. A survey of Kareliya is used as an example of the capabilities offered in terms of geological interpretation of the images produced with the new technique. The survey is performed with the Resurs-F system and the experimental Resurs-01 system. The camera aboard the Resurs-F has a focal length of 1 meter and produces high-quality images in a scale range of 1:50,000-1:200,000. Several Resurs-F satellites are launched every year, and they operate for two weeks. The Resurs-01 satellite uses a high-resolution MSU-E CCD scanner that operates in three spectral channels—0.5-0.6 μ, 0.6-0.7 μ, and 0.8-0.9 μ. At 2-3 years, the satellite's operating life is considerably longer than that of the first. The data collected by the Resurs-01 is relayed to centers where images with a scale of 1:250,000 are produced. The MSU-E unit is designed to scan at nadir and across the track with the optical axis at an inclination of 30°. Figures 3.

NPO Energiya Attempting Development of Batteries, Fuel Cells Based on Buran Technology

937Q0113A Moscow DELOVOY MIR in Russian 12 Mar 93 p 13

[Article by Sergey Khudyakov, candidate of technical sciences and deputy chief of the department for the development of the electrical power system of Buran: "A Power System Useful to Everyone"; first three paragraphs are source introduction]

[Text] **The hard times that power-engineering is going through are forcing everyone to think about new sources of energy and about nontraditional means of producing it. One such method—electrochemical—has long been known to a small circle of specialists, but is virtually unknown to consumers of thermal and electrical energy. That's because electrochemical energy has been developed for space needs, not ground needs.**

Academician S. P. Korolev NPO Energiya has created a power system for the manned spacecraft Buran, and that system's time has come to operate for various sectors of the economy.

We asked the deputy chief of the department for the development of the Buran electrical power system, Cand. Tech. Sci. Sergey Khudyakov, to present the system to you.

In 1970, NPO Energiya and the Ural Electrochemical Combine, the Ural Electromechanical Plant, and a number of other enterprises developed a power system based on electrochemical generators with hydrogen-oxygen fuel cells for the Soviet lunar mission that was being planned at the time. In the ensuing years, in the context of the same cooperative arrangement, but this time for Buran, a power system containing four Foton electrochemical generators was developed. Now NPO Energiya is creating similar, ecologically clean power systems for the needs of the economy. And just what does that work entail?

One can arbitrarily separate it into three areas. The first is the development of power systems based on alkaline electrochemical generators that operate on hydrogen and oxygen. As we see it, the most effective realm of their application involves underwater apparatuses used for various purposes. For example, research, diving, and rescue vehicles working on the shelf and farther out at depths of up to 1,000 meters, as well as deep-water research vehicles operating at depths of up to 6,000 meters.

The power system being proposed is competing successfully with power systems based on the lead-acid batteries in use today, as it increases four- to fivefold the amount of time a vehicle can stay underwater and the range of underwater maneuvering.

Our specialists have already made several preliminary designs of the power system both with cryogenic storage of hydrogen and oxygen and with gas-bottle storage. Research has shown that, at ratings of 25-30 kW and power capacities of 300-400 kW/hr, gas-bottle storage is better; at higher power capacities, cryogenic storage is better.

Using the Foton electrochemical generator and a number of other units and assemblies of the Buran power system, it will take 1.5-2 years to develop and manufacture an operative power system and to deliver it to a client.

Another area involves the creation of a hydrogen-oxygen battery based on hydrogen-oxygen fuel cells and electrolysis cells for special mobile devices. The battery under development will have a specific power capacity that is 1.5- to twofold greater than that of the silver-zinc battery (the best of existing batteries) and four- to sixfold greater than that of the lead-acid battery, which is the most widely used battery.

The new hydrogen-oxygen battery, with a specific power capacity of 100-140 W-hr/kg, can be used, for example, in robotic complexes designed for cleaning up after accidents at nuclear power plants (a preliminary design of a hydrogen-oxygen battery for such a complex has

already been drawn up). Such batteries can find application in gas and petroleum fields, in coal mines and other mines, and, in the future, in electric vehicles.

In three years, we could develop and manufacture an experimental model of the hydrogen-oxygen battery and deliver it for testing.

We are also trying to create a power system based on phosphorus-acid electrochemical generators that operate on natural gas and atmospheric air.

If electrochemical generators with alkaline fuel cells can operate a lengthy period of time just on sufficiently clean hydrogen and oxygen, electrochemical generators with phosphorus-acid fuel cells can operate for a lengthy period of time on a mixture of hydrogen (65-75 percent) and carbon dioxide (25-35 percent) as the fuel and atmospheric air as the oxidizer. In which case, one could use gases and liquids that contain large amounts of light hydrocarbons (natural gas, casing-head gas, gas condensate, biogas, and methanol).

Among the other advantages of this type of power system are its ecological cleanness and its high electrical efficiency (40 percent), and if heat is used, the total efficiency reaches 80-85 percent.

The creation of such a power system will take four years. In the meantime, NPO Energiya, based on initial data provided by the Gasprom and Transmash concerns, the Rosneftegas corporation, the State Commission on Geology of the Russian Federation, and the Russian Scientific Research Institute of Rural Electrification, has developed preliminary designs of power systems based on phosphorus-acid electrochemical generators that operate on natural gas (casing-head gas) and atmospheric air, with ratings of 20 kW, 100 kW, and 1,000 kW. The first phosphorus-acid fuel cells and their assemblies are already functioning.

We are certain that as ecological requirements stiffen and the cost of all types of fuel grows, and as the use of oil and petroleum products diminishes, power systems based on phosphorus-acid electrochemical generators will, in the near future, become irreplaceable for the supply of electricity and heat to the most varied of consumers—gas producers, petroleum producers, and geologists. Such power systems will be effective on livestock and poultry farms, in the lumber industry, on individual farms, and in hotels, hospitals, and laundry facilities (where, in addition to electricity, heat is needed, as are hot water and steam), not to mention in main-line and switching diesel locomotives, city buses, and quarry dump trucks and in river and maritime vessels. Abroad, intense work in the creation of power systems based on phosphorus-acid fuel cells is under way in the United States, Japan, Western European countries, China, India, and Brazil. The work is generally financed by the state and by private firms.

All the money allotted to our association goes for space research only. And the "grounding" of space technologies in a minimum volume is financed by the Ministry of Science's conversion department only. In fact, a tiny glimmer of hope has just appeared: the Ministry of Fuel and Energy's Committee for Machine Building for the Fuel and Energy Complex and conversion has prepared a design for a program involving the participation of the defense sectors of industry in the development of a fuel and energy complex that includes our developments. The question is, Will the program be approved by the government?

We need clients and partners. Both from within the country and from abroad. Only joint efforts will be able to guarantee an entirely safe "grounding" of Foton.

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Prospects for Cooperation With U.S. on Combined Space Station Discussed

937Q0140A Moscow ROSSIYSKIYE VESTI in Russian 1 Jun 93 p 8

[Article by Dmitriy Payson, under the rubric "Life": "We'll Build a Space Station for a Piece of Bread"; first paragraph is source introduction]

[Text] **Arriving in a new place, man looks around begins to build himself a home. He pitches a tent in the taiga. He hacks out a hut in the jungle. He sets up a drift station on the Arctic ice. It was worth it for man to go into space, and just 10 years after Yuriy Gagarin's flight, the first "space home"—the Soviet Salyut orbital station—went into orbit. Its launch, on 19 April 1971, marked the beginning of the actual exploration of near-Earth space.**

From Almaz to Mir

As we near the end of the twentieth century, we probably can't prove the necessity or the economic advisability of space flights. For what, exactly, can you do in space if you can't stay up there a little longer? Regular astrophysical observations, biomedical research, observations of the Earth's land masses and oceans, production experiments—all those things are difficult and sometimes just plain impossible without cosmonauts on a long-duration station in near-Earth orbit.

ROSSIYSKIYE VESTI has already used its pages to write about the first steps taken by our program for developing and operating orbital space stations ("Salyut and Star Wars," ROSSIYSKIYE VESTI, No 95, 21 Nov 1992). We know that the basis for all our "space homes" was the military observation station Almaz, which was developed in the KB [design bureau] of Academician Vladimir Chelomey (in Reutova, near Moscow), the KB Salyut, and the Khrunichev Plant. As a result of the customary race for preeminence, for speeding up the readiness of the station, the Almaz was outfitted with some of the gear of the Soyuz spacecraft of another of our leading design bureaus—the design bureau created by Sergey Korolev, which at the time was headed by Vasiliy Mishin. Salyut lifted off on 19 April 1971, before the Americans sent theirs up. It wasn t until the spring of 1973 that they sent their Skylab up, after they had wrapped up the Apollo program. After that, the "relatively civilian" Salyuts and the Almaz reconnaissance craft (by the way, also called Salyuts, for purposes of secrecy, apparently) alternated with each other in terms of launches.

By 1986, the cosmonauts had been working continuously on four Salyuts and two Almazes—Almazes, by the way, that were somewhat "abridged" by comparison with the initial design. In February 1986, Salyut 8 was to be sent into space, but as a sign of the Soviet Union's peaceful intentions, it was renamed Mir [Peace].

Initially, the Mir orbital station kept the main features of its predecessors. Its basis was, as usual, the hull of the Almaz—maximum diameter, 4 m 15 cm (the "magic number" for our rocket builders, because spacecraft of larger diameter couldn't be transported to the cosmodrome by railroad—no matter how much you "worked" with the railroad dimensions, it wouldn't make the turns); length, 13 meters, weight, nearly 21 tons. But six docking ports enabled the new station to accept not only the 7-ton Soyuzes with cosmonauts and the unmanned Progress "freighters," but also the reoutfitting modules—the additional science laboratories and the living spaces. The modules were developed by KB Salyut on the basis of the Chelomey transport resupply craft—a heavy craft initially intended providing everything that the Almaz needed. Later, modules were made out of the spacecraft. Right now, docked to the already fairly obsolete base unit of Mir are three modules—the Kvant astrophysical module, the Kvant 2 reoutfitting module (module D), and the production module (module T), which is Kristall. With the arrival of the modules, the inside space of the station grew, new science gear appeared, the control system got new capabilities. Finally, on the Kvants and the Kristall, additional solar arrays showed up, as did the newly developed "space chair"—a system the cosmonauts used to get around with outside the station, it's a heavy backpack with rocket motors. At present, the station, without transport craft, weighs more than 67 tons. Depending on what "transporters" are docked to Mir, the station may be 40-50 meters long. Right now, Gennadiy Manakov and Aleksandr Poleshchuk are working aboard the complex.

There is no other manned space station similar to Mir in existence right now, and, it would seem, we won't see one in the near future. But that, according to Strugatskiye, is another story altogether.

Mir 1-1/2, Mir 2, and others

What now? The main unit of Mir is gradually wearing out; it is already in its eighth year of operation, whereas even the longest-lasting of the Salyuts weren't aloft for more than five years. Waiting their hour on the ground are the two last modules—Spektr and Priroda; they're "fresh" modules, with unused service lives, and it seems that they won't have to dock with the ageing Mir. Although in January of this year, there was talk of the possibility of putting them in orbit within a year. Also under discussion is the so-called Mir 1-1/2: Buran would be used to deliver a new base unit (since the Khrunichev Plant has gotten the hang of things with the stations—so much so that it is manufacturing them for foreign museums almost to the point of series production—putting together a flight model won't be a problem), then some of the modules would redock to the new base unit, and the obsolete modules would be discarded into the atmosphere with the old Mir. But it is felt that Buran is needed to execute the project, and things are not good with Buran. Our space program will probably have to choose between Buran and the orbital station—so the Mir 1-1/2 version is innately contradictory.

But what about Mir 2? From time to time, NPO Energiya publishes in the press revised versions of the next-generation orbital station. Initially, the talk was of a

station assembled out of heavy, 100-ton units lifted into orbit by the Energiya rocket. Then Energiya and Buran became enshrouded in some kind of fog, and the projects had to rely on existing rockets, the bigges. of which—Proton—capable of lifting only about 20 tons—21 tons maximum—into space.

But appearing on the scene now are some specific conditions. The specifics consist in the fact that our head organization for the Mir stations and for the manned space program in general is the Kaliningrad-based NPO Energiya. But Mir's base unit, the heavy modules modelled on the resupply craft, and even the Proton rocket itself were developed by the Chelomey people in Reutova and in KB Salyut. Strictly speaking, the initial Mir design didn't call for the use of modules developed by a "competing organization." Instead of 20-ton modules, 7-ton modules based on the Progress craft were to be sent to the station. One of them was even tested—in 1990, under the name Gamma. There wouldn't be any problems with them. The capacities of the Energiya would be loaded, and it's preeminence would be indisputable. Of course, the then-director of the program for the development of orbital stations—Konstantin Feoktistov—feels that the use of lighter modules is totally justified in technical terms. It makes it possible to make the station more "flexible," and modules can be replaced with new ones more quickly. But the decision to make the modules 20-ton modules was, in the words of Professor Feoktistov, forced on the developers from "above."

In any case, the 7-ton modules are again appearing in the designs of Mir 2. Plans calls for docking to the base unit—the same kind of unit now in orbit—four 7-ton modules: a service module, a production module, a biotechnology modules, and a docking section. But the solar arrays and the various kinds of science gear are to be placed on an outside trusswork structure—an open-work, but very strong structure whose various elements have already been tested in space.

There are many critics of the Mir 2 versions that have been prepared by Energiya. The heavy-module developers say that the service gear alone—the communication antennas, the docking and orientation motors, the docking ports, and other necessary things—take nearly seven tons of the total 20 tons of weight. So how much will be left for science gear if the modules are 7-ton modules? Will the service gear be lighten a little?

There are a lot of questions. But this spring added some questions unexpectedly. It all had to do with the fact that the "cold war" ended. And also with the fact that

The Rich are Also Crying

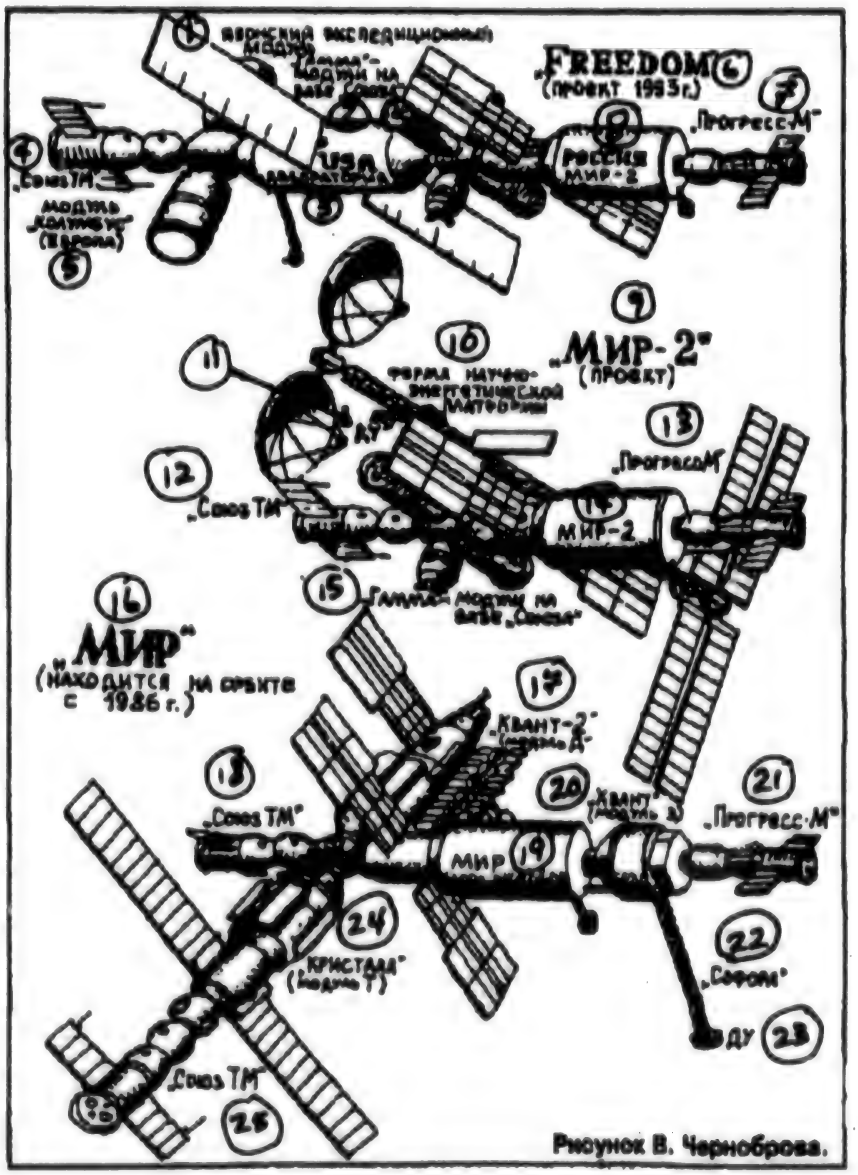
In early May, information agencies around the world reported the premature end of the American Strategic Defense Initiative (that's SDI, or Star Wars). With the abrupt warming of the political climate on the planet, Democrat Clinton didn't consider it possible to spend billions and billions on a "space shield." But a month earlier, yet another grandiose American program suffered a heavy blow—the program for developing the manned orbital station Freedom.

Instead of $30 billion, it was suggested to the station's developers that they get along with $5-9 billion over five years. "We must come to terms with the fact that the old Freedom project simply no longer exists" was the response of Daniel Goldin, the administrator of the American National Aeronautics and Space Administration. "It is no more, and we have to realize that."

In cutting back the appropriations, the White House at the same time "hinted transparently" to the engineers where they should expect help. It was recommended to NASA that it begin joint work with the Russian space-hardware developers.

There are two possible scenarios of Russian-American collaboration in the development of an orbital station. The first—the more realistic of the two—proposes the use by the Americans of individual Russian technologies and specific vehicles to lower the cost of developing the station and putting it into orbit so as not to duplicate what has, so to speak, already been done. For several months now, specialists from NASA and Energiya have been studying in-depth the idea of using a Soyuz craft as a crew rescue vehicle for the American station—a Soyuz is much less expensive than the Shuttle, even though it is used just once, and it's reliability has been confirmed by numerous manned and unmanned launches. Relatively recently, our Proton was proposed to the Americans for use along with the Shuttle for lifting individuals units of the Freedom station—again, the Proton is much less expensive. Finally, the conversation may move to the use of individual elements of orbital stations—e.g., docking ports, automatic rendezvous system.

The second scenario is much more "adventurous." It calls for joint assembly and operation of one orbital station "for everyone," because European and Japanese modules and a Canadian robotic arm were part of the Initial American design. On 16 March, Russian Space Agency General Director Yuriy Koptev and Energiya General Designer Yuriy Semenov proposed to NASA that there be a collaboration in the development of such a station. Pictures depicting a sort of "mixture of a bulldog and a rhinoceros" appeared in the press very quickly. But the 25 April issue of MOSKOVSKIYE NOVOSTI devoted an entire page to the topic "Russia Is Giving Away Cheap Its Quality Commodity—Rocket and Space Technology." By the way, by "cheap" is meant that the Americans would save $7-8 billion by paying us "just" $2.5-3 billion. I don't even want to translate that into rubles. But it's not for nothing that our launch systems and many other space systems are cheaper than foreign systems, whether you're counting in rubles or in hard currency. Please, that is the source of the savings. And in light of the fact that the "space" budget approved by the Russian Supreme Soviet does not even reach 100 billion rubles, one obviously shouldn't talk about "cheap."



Key: 1) Japanese mission module; 2) Gamma—modules based on Soyuz; 3) USA laboratory; 4) Soyuz TM; 5) Columbus module (Europe); 6) Freedom (1993 design); 7) Progress M; 8) Russia Mir 2; 9) Mir 2 (design); 10) Truss structure for science-and-power platform; 11) Propulsion system; 12) Soyuz TM; 13) Progress M; 14) Mir 2; 15) Gamma—modules based on Soyuz; 16) Mir (in orbit since 1986); 17) Kvant 2 (module D); 18) Soyuz TM; 19) Mir; 20) Kvant (module Z); 21) Progress M; 22) Sofora; 23) Propulsion system; 24) Kristall (module T); 25) Soyuz TM.

A 'Free World,' or a 'Peaceful Freedom'?

No matter what is said, a joint space vehicle is a very complicated matter. Many relate to such an idea with skepticism. Problems also arise with putting individual parts into orbit—the Russian and American space launch facilities enable the placement of cargoes into different orbits, and the choice of a single orbit is an extremely complex matter fraught with compromises that are not always justifiable. Finally, no one, it would seem, argues the needs to conduct aboard orbital stations various "applied," or more simply put, military studies, observations, and experiments; how the Americans, Japanese, French, and Russian cosmonauts are going to conduct them simultaneously is a mystery.

In addition to everything else, it is still not clear whether Russia will restrict itself to participation in the building of this "centaur," or whether it will also maintain a purely national program for the creation of orbital stations. As Yuriy

Semenov asserts, Russia at present plants to create a second-generation Mir, and without American participation.

In any case, the work is in full swing. Recently, a representative delegation of Russian designers and industry leaders—from the Russian Space Agency, [NPO] Energiya, and [KB] Salyut—visited the States. The overall coordination of the participation of our specialists in the American program will be handled by the University of Maryland science center, which is headed by the former director of the Moscow-based Space Research Institute, Roald Sagdeyev, who now works in the United States. In the meantime, specialists from the Houston-based Johnson Space Center—the chief developers of the American station—walk around in football jerseys that say, sarcastically, "We'll build the space station for a piece of bread." A sense of humor, so to speak.

Time will tell. We hope that we will soon be able to tell the readers of the results of the negotiations between our specialists and their American counterparts. Will we be going aloft together?

Mars Flight Plans Subject to Change, 1994 Mission to Use Single Spacecraft

937Q0137A Moscow SEGODNYA in Russian
No 17, 18 May 93 p 7

[Article by Mikhail Chernyshov, under the rubric "Space": "We Will Fly to Mars, But We Will Leave the Mars Rover on the Ground"]

[Text] Reports have emerged in the Western press that the Mars-94 project is again in danger of being canceled because of financial difficulties. That program has been through so many transformations that it's almost impossible for the latest bit of "news" to surprise anyone.

In the past, the United States and the USSR conducted a desperate race for prestige to land a man on the Moon. The Americans won. But that's OK, we were assured by the space-sector bosses, because we'll get our revenge in the Mars marathon. And a rather streamlined program for manned flight to the "red planet" was developed, broken into a number of stages. The program's peak was to be the visit to Mars by a man in about the year 2005. But unmanned vehicles would have to support the landing.

For many years, the United States and the USSR were "neck and neck" in launching unmanned probes. Each of the two competitors would trade either moving a head just a little or falling behind a bit. But each one had its own special achievements: the Americans were stronger in terms of techniques for acquiring and processing information, whereas our specialists garnered more experience in controlling spacecraft, especially in the realm of unmanned landings.

Specialists tried to collaborate in almost every stage of execution of the Mars programs in one country or the other. But broad cooperation never happened. The amount of cooperation would depend on the political climate.

One of the last periods of thaw was the late 1980s, when the United States announced a "new space policy" that called for the creation of a base on the Moon and a gradual transition after that to manned Mars missions. That, by the way, represents one of the principal differences from our programs: the lunar intermediate "step" never figured in as a mandatory element.

But there are some elements that match up completely. Specifically, the dispatches to Mars of an unmanned vehicle that could take a soil sample and deliver it back to Earth. The U.S. Congress, always cool to the idea of financing such projects, strongly recommended to the Reagan administration and to NASA that close ties be set up with Mikhail Gorbachev in order to attempt to execute the project via the efforts of both countries and thereby alleviate the burden of spending for both. But times changes, just as presidents do.

Our last Mars missions took place in 1988 and 1989. The program was called Fobos. It assembled a grand team of participants—more than 15 European countries, joined by the Americans. Unfortunately, both probes, upon approaching Mars's natural moon, failed. Nevertheless, there were some tangible results, so that the failure generally didn't cool the ardor of the participants. Everyone decided amicably to also work together on the two next Mars-94 probes. Moreover, with time the team of researchers grew even larger.

The Lavochkin KB [design bureau], where the overwhelming majority of our interplanetary probes are developed, promised to take the mistakes into account and improve the vehicles. And the planetologists were faced with determining the optimum composition of the research equipment. It was suggested, for example, that huge balloons be used that would float in the Martian atmosphere. At night, the balloons would be secured with special anchors suspended by cable—guide ropes. Also designed for Mars-94 were small self-propelled carriages that would be somewhat similar to the lunar rovers. In a word, the work on the project got under way quite energetically. And then came the onset of the post-perestroyka times. True enough, several months ago, a sort of optimistic report came out: money for the project had been released, and the work would continue. Moreover, a decision had been made that if the money suddenly ran out, some would be taken from some other programs. The project would be carried out at any price. True, the project's face has changed somewhat. In 1994, only one probe, not two, will go to Mars, and there won't be any Mars rover on it. The rover will be put on the vehicle that will be sent to the planet in the next convenient launch window—in 1996. But no one can guarantee that that will definitely happen.

In the past, operating in our space program was a principle of extremely rigid planning. Moreover, the Americans borrowed that principle from us and, as already mentioned, managed to win the race to the Moon. But these are different times, different approaches. Only one thing is clear: the "principle of a very large degree of approximation" will not, of course, help things out.

Economist Defends Effectiveness of Space Programs

937Q0136A Moscow ROSSIYSKIYE VESTI in Russian 12 May 93 p 3

[Article by Yuriy A. Abramov, docent, Economics and Organizing of Production Department, Moscow City Technical School imeni Bauman, "Money From the Sky. Space Also Is Being Transformed Into a Sphere of Commerce"]

[Text] The first stage in the development of cosmonautics was not based on the ideas of economic efficiency, but on high-prestige scientific and military interests. Economic indices could serve only as a natural limitation on the capabilities of one country or another or a group of countries. This period ended, evidently, at the beginning of the 1980's.

The second stage is characterized by the fact that space technology, developed from the start and improved at the expense of the government, in its individual aspects is being handed over for use by departments and enterprises for application in commercial activity. It is evident that they can undertake this only after receiving guarantees of its future profitability. This means that the problem arises of determining the time when space technology will become profitable.

The third stage in the development of cosmonautics will evidently begin already in the next millennium. During this period cosmonautics will become a field of commercial activity which completely pays for itself. In other words, the profits from it will make it possible to carry out expanded reproduction and promising scientific development work. The government, however, will take upon itself only the implementation of the most grandiose scientific research projects and programs, those which in actuality promise prosperity to all society and future generations and at the same time are too costly for individual intergovernmental associations and commercial organizations.

Space technology, in comparison with other fields of technology, is so effective that it had to be developed even if it initially was not profitable. But now it already is highly profitable. Doubts along these lines are attributable to the completely primitive, incompetent methods for calculating economic efficiency which have been used in scientific work in our country.

The expenditures on space, including economic and scientific projects, are negligible against the background of the inconceivable losses in our economy. For example, in 1989 (in the USSR) 1.7 billion rubles were spent on space. However, the losses were as follows:

—unfinished construction

—200 billion rubles;

—industrial reserves above the norm

—250 billion rubles;

—simple machine tools (adequate for 1.3 work shift)

—50 billion rubles;

—uninstalled imported equipment;

—7 billion rubles;

—not less than ten other such major items.

An indisputable advantage of space technology is manifested in the fact that it most naturally fits into any conversion program. Indeed, in this case there is no need for selecting artificially the items for peaceful purposes most suitable for production.

The demonopolization of the space industry and taking it out of the hands of the government will be accomplished predominantly in the form of organizing of joint stock companies and joint stock enterprises. Western entrepreneurs have become extremely interested in the use of the advances in national cosmonautics. Accordingly, it is possible to expect the appearance of a considerable number of joint enterprises.

The economic possibilities of development of national cosmonautics are dependent on two definite factors. First of all, internal: on the favorable or unfavorable outcome of transformation of the economy into a regulated market economy. But also external: the degree of opposition of the two principal forces in the modern world.

Appreciable practical shifts, understandably, are dependent on solution of strictly scientific problems in the space economy. We will call them the most important terms. It is necessary, first of all, to improve the methods for calculating expenditures on each individual project, as well as to develop methods for an adequately precise evaluation of the results of use of space technology. It is necessary to find the criteria and indices of economic effectiveness for projects and programs, to develop methods for optimizing design and technological solutions applicable to space technology. It is impossible to get by without a substantial increase in the accuracy of long-range prediction (by 20-30 percent) even beyond the economic horizon. A decisive role is being played by application of the principle of programmed purposeful planning with optimization of resources. Cooperation with the world economy, information systems and science is putting a natural final touch on the space economy for an efficient division of labor.

Despite the fact that the principal resources of the space industry and cosmonautics remain government property, even under conditions of a decentralized market economy, interest of entrepreneurs in them is great and is not abating. There is an explanation for this.

The most important consideration is the very high level of technology and construction, making it possible to compete on an equal basis (and in some cases, on a superior basis) on the world high-technologies market. The enormous production facilities set free as a result of a reduction of military orders also are attractive. And, finally, a factor meriting particular attention is the maximum possible, under present-day conditions, economic efficiency in operation of rocket-space technology in the world economy. Some commercial enterprises, penetrating into this sphere, such as the "IBK" company, are already earning significant profits. Their experience awaits our analysis.

For a broadbrush analysis it is reasonable to divide all the spheres of civilian use of space technology into three fields: communications, monitoring and technology. What applications are included in these fields? Communications takes in the transmission of data, radiobroadcasting, television, navigation, rescue of those who have experienced misfortune and education (teaching). Monitoring exerts its influence on: environmental protection, exploration for minerals, soil science, observation of crops, meteorology, forestry, fish reconnaissance and mapping. The technology field, according to our breakdown, includes: power production, metallurgy, preparation of pharmaceuticals, production of ultrapure materials, delivery of freight, burial of wastes and weather modification.

And this, it goes without saying, is not all. In addition to the mentioned applications, there is also the very extensive sphere of scientific research and national defense.

Today how is it possible to estimate the economic effectiveness of use of space technology in the economy?

Satellite communication systems are the most profitable: these include telephone, telegraph, FAX, radiobroadcasting, television and transmission of technological information up to and including the transmission of matrices for the local printing of central newspapers. In the prices of 1989 the savings from communication satellites were estimated at 0.5 billion rubles.

Several thousand of our county's ships, outfitted with the "Tsikada" space navigation system, can with the greatest possible accuracy determine their coordinates in the world ocean, which makes possible a savings of fuel and reduces the duration of cruises by 3-4 percent.

The increase in the accuracy of meteorological forecasts by means of space monitoring, according to 1989 estimates, yielded a savings of 0.5-0.7 billion rubles per year. (These figures are far too low, possibly by a factor of 3-5). This function of cosmonautics may reduce crop yield losses by 7-8 percent, which is about 7 billion dollars. Such an estimate is consistent with the experience of other countries.

By the year 2000 it would be possible to increase the magnitude of space production of particularly pure materials, biopreparations, semiconductors and drugs to a sum as great as 10 billion dollars annually.

These economic impact figures were calculated as a minimum. There are, for example, such estimates as that the military space programs increase the combat effectiveness of all the armed forces by a factor of 1 ½ (in this respect our estimates coincide with American estimates). Then, assuming that the annual military budget of the Union during recent years has been 80 billion rubles, we obtain 27 billion rubles in reduced expenditures on the army and navy annually.

Now a new theory has been formulated for calculating economic efficiency under market conditions which takes into account as a minimum four fundamental economic constants. Reference is to the banking and entrepreneurial percentage, the mean rate of overturn of fixed capital and the average rate of overturn of circulating capital in the economy. With a correct determination of these constants it is possible to calculate the magnitude of the economic impact with an accuracy to three significant figures, which completely satisfies today's entrepreneurs. And this, in turn, will assist in a clearer visualization of the outlines of future cosmonautics and will bring celestial and terrestrial realities closer to one another.

Problems in U.S. Space Station Program, Plans for 'Mir-2' Proceeding

937Q0134A Moscow NEZAVISIMAYA GAZETA in Russian 6 May 93 p 6

[Article by Anatoliy Zak, under the rubric "Project": "Chaos in the American Space Program, Which, As Never Before, Means a Lot for the Russian Plans to Explore Space"]

[Text] For several weeks now already, hundreds of scientists and designers from more than 10 countries participating in work on the design of the permanently orbiting space station Freedom have been in a state that can be summed up with the word "confusion." At the source of it all is the fact that, in late February 1993, President Clinton's administration ordered the National Aeronautics and Space Administration (NASA) to begin a revision of this multinational program in order to save money. Since the day the Freedom project began, in 1984, the attempts of the opponents of the station to shut the program down have been commonplace, and as a result of those efforts, the project has been scaled down several times to a more modest, less expensive version. Until now, all those changes have taken place largely on paper or on computer screens; but the current order for revision means that designers are back at the drawing board at a time when the first components of the future settlement in space have already begun to come off the assembly line.

It will take at least a month and a half before it becomes clear what the Freedom design will look like this time. At

worst, there will be no room at all for NASA's foreign partners. Until now, it was assumed that Japan and the European Space Agency would build two completely outfitted laboratory modules that would be docked to the "nucleus" of the station. In the current situation, virtually all the Freedom project participants have, to some measure, "turned to the East," that is, to Russia. Their hopes are pinned on the Mir-2 project, to which the Freedom program participants who find themselves thrown overboard could "link up." "We are ready to re-orient our program to the East if the changes in the American plans force us to do that," said a representative of the German space agency in a recent interview with the weekly AVIATION WEEK & SPACE TECHNOLOGY. At present, Germany is shouldering 38 percent of all the expenses associated with the creation of the European habitation module that would be part of the Freedom station.

For its part, Russia certainly has something to offer any potential partner in the field of manned spaceflight. The most difficult times appear to have passed for our space program. In an address on 12 April 1993 at a state meeting dedicated to Space Program Day, Yuriy Koptev, the director of the Russian Space Agency (RSA), said that there can be no talk today of ceasing flights of Russian cosmonauts. Putting the axe to the grandiose, but not very effective Energiya-Buran program, the RSA thereby freed up 40-45 percent of the resources of the entire civilian space program. Moreover, according to reports from the Russian Supreme Soviet, space spending for this year in the state budget has been increased roughly twofold and stands at 51 billion rubles [R] (in beginning-of-the-year prices). Thus, the Russian space station on which our cosmonauts will ring in the 21st century has been assured a more or less guaranteed future.

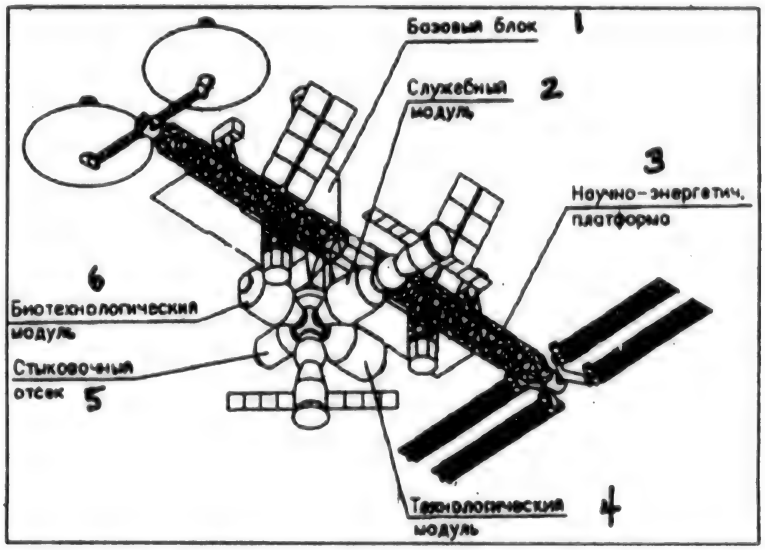
Based on a very sober-minded assessment of the difficult economic situation the country finds itself in, Russian designers from the very beginning conceived of Mir-2 as being smaller than Freedom. That may free them from the thankless work associated with "cutting back" an already designed station to satisfy the whims of the political situation. At the same time, the design is showing several advantages over the future American space settlement. Inexpensive expendable launch vehicles will be used for the assembly and transportation associated with the Mir-2 station, whereas the Freedom design has always been based entirely on the use of the manned Space Shuttle vehicles. So, as early as after the first launch of the base unit of Mir-2, in 1996, the Russian station will be ready to take on a crew; whereas in the American version, that will take place only on the sixth flight of the Shuttle.

But the traditionally weak point of Russian space vehicles consists in their electronics and their instrumentation. In light of that, the participation of Western partners in the Mir-2 project could raise the scientific potential of the future station considerably. According to Leonid Gorshkov, the chief of the NPO Energiya section for the design of Mir-2, the science gear for the station has not been chosen yet, but it has already been decided that one of the modules will be dedicated completely to the production of biological preparations and another, to experiments in materials science.

In the meantime, the Mir-2 and Freedom projects are being carried out completely independent of each other. And Leonid Gorshkov calls that situation unintelligent. "At a time when the financial capabilities of the government sector are declining throughout the world," says the lead designer of our orbital stations, "it's hard even for the richest country in the world to finance a space program in isolation." Coordinated execution of both projects could ease the financial burden of all participants and could raise the efficiency of future stations.

The central element of the entire complex is the base unit, which is to be placed into orbit by the Proton launch vehicle in 1996. At a later state of station development, another base unit can be set up parallel to the first. The station will be placed into orbit with an inclination of 64.8° The orbit will be considerably more to the north than that of the Mir-1. That will make it possible to send cargo resupply vessels to the station from the Russian Plesetsk cosmodrome. Right now, a launch complex with two launch pads for the Zenit launch vehicle is under construction at our northern cosmodrome. The Zenits are expected to be used to place new, expanded versions of the Soyuz and Progress craft into orbit, as well as the 10-ton side modules of the station that carry the service systems and the science gear.

Quite recently, the designers decided to incorporate in the station's structure an additional "node" module, which will serve as a unit that enables the linkup of the base unit and special-purpose modules. It will be the basis for attachment of the station's main truss, which is called the science/power platform. Dishlike structures on one of the platform's ends serve to focus the sunlight that drives the station's electric generators. Attached to the truss will also be solar arrays, maneuvering engines, and the radiators that release excess heat into space.



Preliminary design of the future Russian Mir-2 orbital station, as prepared by NPO Energiya.
Key: 1) Base unit; 2) Service module; 3) Science/power platform; 4) Production module; 5) Docking section; 6) Bioproduction module

U.S. Seen Taking Advantage of Russia in Cooperative Space Projects

937Q0133A Moscow MOSCOW NEWS in English No 17, 23 Apr 93 p 11

[Article by Sergei Brilev and Andrei Kolesnikov]

[Text] Recently every effort has been made by Russia to cultivate a myth about cooperation with the USA in order to sustain the vital tone of Russia's space sector. Pertinent agreements have already been signed between the Russian Space Agency and NASA. In truth, this myth has been created to hide the Americans' desire to quickly and cheaply buy our development projects in the field of high space technologies.

Initially this desire peaked in February of last year, coinciding with the breakdown of the Union and the financial confusion in Russia's space research programmes. At that time USAF questioned whether to spend 7.5 million dollars for a stand model of the Topaz-2 reactor developed under the guidance of Moscow's Academician Nikolai Ponomarev-Stepnoi. The sum was ridiculous.

America did not conceal that they would be able to develop a similar apparatus only at the beginning of the next millennium. They hoped to get a multimillion economic effect by including Topaz-2 in the SDI programme, although initially they claimed that the nuclear power plant would be mounted on a spaceship which would fly towards Mars.

After much bargaining Topaz-2 was sold to Aemricans for 7.5 million dollars. This was officially announced by Washington in April 1992.

As it could be expected, the deal did not solve the Russian space industry's financial problems. The internal reserves having been depleted, the state had no money. A hand was again extended to us from across the ocean. True, they are not going to let Moscow into the international market of space services (e.g., putting satellites in orbit on our carriers). In keeping with the laws and national interests of the United States, the sale of technology to socialist countries was possible solely with a sanction from the Department of State. The COCOM restrictions are also in effect. Today everything is clear about the socialist camp, but national interests remain—the USA is not going to tolerate rivals on the market and is very sensitive to the demands of its national security.

Therefore we must sell not services but high technologies through which we can offer these services. Possibly for this reason the US Congress, in the middle of last year, lifted the restriction on the import of high technologies from Russia. But these technologies' movement in the opposite direction remained nevertheless under the control of COCOM and the Department of State.

Incidentally, the Old World, where the Hermes shuttle craft is being created in the framework of the European Space Agency (ESA), is also lagging behind in the development of a number of technologies. Emphasizing that Russian space goods are several dozen times less expensive than their American analogues, the ESA intends to buy the technology of heat protection for the Buran spacecraft.

In October Yuri Koptev, Chairman of the Russian Space Agency (RSA), and Daniel Goldin, administrator of NASA, signed an agreement in Moscow on an American's flight on the Mir station and a Russian's flight on a Shuttle mission, and also on cooperation in preparing an expedition of robots, and also humans, to Mars.

Under this project, says Gennady Khromov, a Russian expert on problems of rocket-space technology, Russia will transfer its entire colossal experience and technical breakthroughs to Americans almost free. There are plans for example, to use our Soyuz TM as an emergency rescue vehicle for the American orbital station Freedom. According to American press reports, this will enable the Americans to save a billion dollars on their own development projects. But according to MN information, at least three billion: our "rescuer" is expected to be sold to Americans for a billion, whereas it would have cost the Americans four billion. Moreover, it will cost us approximately 800 million dollars to develop the "rescuer." As estimated by the RSA, the project for docking Mir and Shuttle will cost Russian taxpayers 12,475 million roubles (in the prices of the fourth quarter of 1992) and two million dollars.

The Americans do not particularly stand upon ceremony with us even in our own programme for launching a Russian automatic probe to be sent in 1994 towards Mars. It has planned to mount two American scientific instruments on it without any compensation at all.

Many Russian scientists have been trying to preserve their presence of mind and be optimistic in this shady game. Specialists' self-possession is short-lived, as a rule. Demonstrating this is our conversation with Pilot-Cosmonaut Oleg Makarov.

"A formerly great country is perishing. But great values—cosmonautics, for example—still remain in its possession. So will these values perish together with us or shall we turn them over to surviving humankind?"

"But isn't there a possibility to sell these values for the money which they really cost and thus save the great country?"

"Yes, there is. But, they won't be bought; second, we don't know how to sell and, third, the Americans no longer have money for us. They have vanquished the Russians in space, and to all appearances, this was the key plank of the American space programme. America has lost interest in space projects. And now NASA is short of money even for the Freedom station. But they want to prolong its life expectancy to 50 years. No matter how hard we may try, we are incapable of this today although we have our new project—Mir-2."

"They say that our space scientists bear a grudge against the Americans. Freedom was said to be an international project, but we have still not been let near to it. Can it really be that they disregard our input to the project?"

"Maybe there were some written understandings on this score at the top. They have not asked us for help. But we know for sure: if the Americans need anything, they will break through walls with their heads. We expected that the Americans would turn to Russian specialists in reference to space technology. And then we would have somehow shaken up our top echelons—it's simpler for us with them, we know them, for they are ours. But Americans have never invited us to cooperate as partners. They kept waiting till we ourselves asked for it. Now they have it. We have asked."

"And in what way is Shuttle interesting for us?"

"There is nothing for us to do there. We are not going to develop such a vehicle, we have no need for it. True, if I were personally offered to fly on it, I would have given my life. Shuttle is a miracle as an engineering breakthrough. Although it may be criticized from top to bottom. The Americans promised, after all, that it would repay its costs after 50 launchings, but it could be seen at once that they were wrong: the vehicle is too bulky for present-day customers. Have you seen American and European motor vehicles? So they have made an American automobile meant not to save petrol but to use it and, moreover, in such a way that everyone should see what a powerful and significant master this automobile has."

"In what then is our Mir interesting for Americans?"

"In everything. Although the station does not have anything which they would like to steal. From a flight on Mir they need confidence: all they have been doing on Freedom is correct. The Americans will make anything we have in a better way. If, of course, Congress gives them the money for this, which is doubtful since the station will be monstrously expensive. And if it doesn't give, then, I believe, the Americans will remember about us (a week after this conversation Makarov's forecast was brilliantly borne out—Authors)."

"And, of course, any technological trifles linked to durable flights are infinitely interesting and dear to them. It has taken us dozens of years to develop them."

"Many believe that political missions are given first place in the case of our cosmonaut's flight on a Shuttle."

Makarov flies into a rage:

"They have no justification on this flight. In effect, we are sending our man to Shuttle for the Americans not to pay us for their astronaut's flight on Mir. Regrettably, I don't know who could have invented this in such a poor country."

"Your point of view has been rapidly evolving even in the course of this talk. At the beginning you were much softer in speaking about the project. Does its failure hurt you as well?"

"Well... In this situation, apparently, there was a need to try and get more. We failed."

Quite unexpectedly for these authors, the culmination came in the form of a sensational announcement reported by all of the world's news agencies. Bill Clinton had announced a reorientation of the Freedom programme to Cooperate with Russia and the need to design a smaller and cheaper station than the one proposed earlier.

Much to our surprise, it proved exceedingly difficult to secure a commentary on this statement. The Russian officials whom we requested to interview gave us only non-committal answers about the need for cooperation with Americans in the space sector.

Vladimir Pivnyuk, a Russian government expert on space issues, alone agreed to comment on the situation. It turned out that Soviet specialists had long noted defects in the Freedom concept, which was being constantly reconsidered. For instance, the inclination of 28 degrees achieved by the American means of delivery to orbit makes it possible to "cover" just the territory of Florida and Texas. Yet the station is geared to the solution of exactly global problems.

Launchings from our territory and on our carriers will solve this problem.

On the whole, Vladimir Pivnyuk believes, Russia is five to seven years ahead of the USA in the development and operation of orbital stations. A month ago, during a visit by Yuri Semyonov, general designer of the Energiya science-production association, to the Boeing firm, the Americans at last suggested giving a serious thought to cooperation. The positive reply, sent in the form of a letter signed by Yuri Semyonov and the RSA's director Yuri Koptev," appeared in the American press. NASA concluded an agreement with the space research centre of Maryland University, led by Academician Sagdeyev, former director of the USSR Institute of Space Research, and NASA's former deputy administrator Keller, on working up the concept of an orbital station with the participation of Russian specialists.

Besides using our theoretical knowledge, the Freedom probe will possibly house the solar batteries, bioreactors and kilns for transistors developed in Russia. A group of 15 Russians left in early April for Maryland to work on the project. The list was compiled by the Americans themselves. Mr. Goldin, NASA's administrator, has said that the Japanese, Canadian and European partners have consented to use the Russian technology and equipment. Most likely, a meeting will soon be held among the heads of the space agencies of Russia, Canada, the USA and Europe who will, at an intenational level, finally bless Russia's participation in the Freedom project.

Judging by the looks of it, the Americans have still been unable to bear up against the superexpensive project. Regrettably, even this decision screens the cynical hopes for the Russian inexpensive equipment. Said Vladimir Pivnyuk: "Given the project's favourable development, we hope to earn 2.5-3 billion dollars. The Americans, for their part, will be able to save 7-8 billion dollars."

KB Salyut Wins Contract for Launch of Inmarsat Satellite in 1995

937Q0132A Moscow RABOCHAYA TRIBUNA in Russian 29 Apr 93 p 3

[Article by Vladimir Lagovskiy, under the rubric "Sensational News": "Sometimes It's Beneficial to Work for the 'Uncle'"]

[Text] For the first time, a Western satellite will be placed into orbit by a Russian launch vehicle.

Olaf Lundberg—the director of Inmarsat, an international organization known for its global communications systems—and Dmitriy Polukhin—the director of the KB Salyut, equally well-known for its orbital stations—have signed a contract in Moscow. In 1995, from the Baykonur cosmodrome, the Proton launcher will lift the Inmarsat-3 satellite into space. The contract will bring us $36 million. And it must be noted with some obvious satisfaction that the promises of the aerospace complex that it would make a lot of hard currency are finally beginning to come true.

The order for the Russian rocket was far from an act of charity. KB Salyut won the tender, competing against American and French companies. Russia got one of four satellites to be launched. To the question of why just one, Mr. Lundberg answered that he leans toward Russian space hardware, but that he's not accustomed to putting all his eggs in one basket. But in the future, the collaboration will probably be worth continuing. First of all, things are cheaper with us. Second, the Proton is one of the few rockets capable of delivering a satellite directly into geostationary orbit. Western colleagues generally take vehicles halfway, and then the vehicles power themselves the rest of the way.

Thanks to Inmarsat, right now any two points on the planet can be linked via satellite and ground-based equipment contained in a case. Such small suitcases, with small dish antennas, made it possible, by the way, for journalists to do on-the-spot reporting to the whole world during the war in the Persian Gulf. But by the end of the decade, that hardware will be updated—in place of the cases will be pocket-sized units (see the photo) [photo not reproduced here]. Just imagine, from somewhere in the Sahara Desert, you push a few little buttons, and you're talking with your wife, who's lonesome for you somewhere in the vicinity of Magadan.

KB Salyut has its work cut out for it. Specialists will have to perform some fairly complicated work to adapt our rocket to "their" satellite. At any rate, the contract—a truly historical step—is a breakthrough into the Western market. And that kind of a chance for our aerospace sector must not die on the pad.

Planned Launch of Inmarsat Satellite, Communication Security of System Discussed

937Q0132B Moscow IZVESTIYA in Russian 5 May 93 p 7

[Article by Matvey Glebov: "Western Communications Satellite Will Be Sent Into Space Atop Our Rocket"; first paragraph is source introduction]

[Text] **The launch from the Baykonur cosmodrome of the Inmarsat-3 communications satellite, which will be delivered into orbit by the Russian Proton vehicle, is slated for 1995. Such is the gist of a $36 million contract signed in Moscow by KB Salyut and the international satellite communications organization Inmarsat.**

The uniqueness of the Inmarsat system consists in the fact that, with a mobile or stationary unit, you can make a telephone call, send a fax or a telex, or use a computer modem to communicate with any place no matter where you are—in the desert, at sea, in the jungle—just the same as if you were in some European capital. The organization itself—headquartered in London—is, in the words of its director, Olaf Lundberg, a unique "international cooperative" in which government communications services from many countries and commercial companies that make direct use of global communication links all get along together. By the way, numbered among the longtime clients of Inmarsat were Soviet fishermen and maritime people, who used two coastal terminals in Nakhodka and Odessa as their entry points into the system.

Today, Inmarsat's clients in Russia are not just the seafaring people. Recently, one Moscow firm began selling Inmarsat sets to businessmen and anyone else who might want them. The mobile unit weighs 34 kilograms.

The price of such a system is $57,950, not counting the user charges—$4-10 a minute for each telephone call or fax call. Such a price is comparable to that of a typical car. In light of the fact that Mercedes and Cadillacs are being sold in Moscow with unprecedented speed, the prospects for the commercial use of the Inmarsat sets appear to be pretty rosy.

The Proton rocket will lift into space a third-generation satellite whose development involved the use of the very latest technologies of the General Electric corporation.

It's curious that the Moscow firm that is selling the Inmarsat sets is advertising the units as "absolutely confidential" units. In other words, it's impossible for the all-powerful special services to eavesdrop on the conversations of the callers. But can that be true?

Unlike the virtually "open" cellular communications—portable telephones made by Motorola, Ericson, and Nokia, which transmit conversations that, at 450 MHz, can be picked up even on amateur radio operators' receivers—the Inmarsat signals are encoded, and you've got to have at least a decoding device to make sense of a conversation. In addition to that, the specialists assure us, the coastal stations at Nakhodka and Odessa don't record the content of the conversations, just the time and length of the conversations.

Mr. Lundberg, however, does not consider the Inmarsat set a find for spies or criminals. Whether they can be listened in on by the satellite communications system is an everpresent problem of poison and antidote: when the encoding devices are improved, the decoders are also improved.

RSA Director Koptev Interviewed on Space Budget, Prospects

937Q0131A Moscow EKONOMIKA I ZHIZN in Russian No 16, Apr 93 p 3

[Interview with Yuriy Nikolayevich Koptev, director of Russian Space Agency, by V. Karpiy and N. Tarasenko, under the rubric "V.I.P.": "Yuriy Koptev, Director of the Russian Space Agency"]

[Text]

[EKONOMIKA I ZHIZN] Yuriy Nikolayevich, a little more than a year has passed since the Russian Space Agency began its operation. What has it accomplished?

[Koptev] I don't think I would be exaggerating if I said that there was a time when, on various levels of legislative and executive authority, the question "to be or not to be" was quite a critical question for the space program, and few could say on which side the scales would tip. Today, those questions are no longer on the agenda, and I would say that the first and main achievement is that we have managed to set up a positive relationship with the legislative and executive structures. The members of the commissions and committees that handle the problems associated with space activity in Russia have approached the determination of the fate of the space program very carefully and thoughtfully. A separate line appeared in the budget of Russia that confirmed that the space sector in Russia is not forgotten.

[EKONOMIKA I ZHIZN] As we recall, there were many disputes about the level at which it would be financed.

[Koptev] They more or less gave us the money... We justified our requests by pointing out that the volume of work that had to be done required a level of financing that would be no lower than that of 1991. That's somewhat less than was doled out before, but in fact we got even less money, and we weren't able to get the insertion of an allowance for inflation, which "ate up" nearly 30 percent of the initial sum.

Nevertheless, as anticipated, 25 civilian vehicles were launched. The operation of all the principal civilian communications and telecommunications systems continued. The program for the launch of all the Earth-resources satellites was performed. About 80 percent of

the program for manned missions was done. We didn't do the planned volume of work on the additional modules for the Mir station. That is, the work associated with the operations program was more or less done. We fell behind in the work associated with the long-range plans and in the work associated with future tasks.

But—and I consider this an important step—in compliance with the decisions made by the President and the government and with the help of all interested departments, industry, and space-information consumers, as well as leading institutes, we managed to develop a program for the civilian space program that goes to the year 2000. For the first time in our history, it went through an independent advisory council, which is headed by Academician Osipov. The interdepartmental expert commission consisted of representatives of all departments and organizations, those involved in the development of space activity, as well as those involved in using the results of space activity.

[EKONOMIKA I ZHIZN] If we understand you correctly, in terms of the acknowledgement of those who have been entrusted to decide the fate of the space program, there was a unique change in favor of a sector that embodies the level of development of the country, its science, and its technology. Has that in any way affected the appropriations for this year?

[Koptev] You understand, of course, that the space program is such a complex, manifold process that we must not restrict in time by being guided by the interests of this very minute. The creation of our vehicles and complexes; the development of an experimental, testing, and production base; the expansion of basic, exploratory, and applied research—none of that can be confined to the framework of a year's time, "from this point in time to that point in time." That is why, in terms of financing, we looked at 1993 through the prism of both the past year and what we want to do in the next seven or eight years. That enabled us to clearly justify the requests of the sector, and in the framework of budgetary messages and the draft law on the budget system of Russia, an amount of money that was 2.2-fold greater (at comparable prices) than that for 1992 was put in for 1993.

As for the change in the acknowledgement... I'd like to believe that it happened. The fact that the sector "opened up" and that trips to the cosmodrome, sector enterprises, design bureaus, and institutes were set up for deputies, government officials, and journalists had its effect. And we'll continue to do that—people should know where "space money" is being spent and on what.

[EKONOMIKA I ZHIZN] And yet, millions of Russian still ask the question, But what does space give me personally?

[Koptev] In the process of working on the state program, we ourselves again became convinced—and I think we managed to convince legislative and executive authorities—of the fact that for Russia, space activity is an important prerequisite for the country's existence as a power possessed of high-level technologies and capable of handling science, technical, and defense tasks on a world-class level.

Russia! If we want to have a normal system of communications and telecommunications across that ever so immense space, have information on the consequences of our technogenic activity, plan intelligently the extraction of natural resources, enable the banking system to work normally, create a full-fledged computer network—I could go on and on with the list—that is, if we want to arrange a normal life here at home, we have to realize that it will be impossible to set up that life without the use of space hardware.

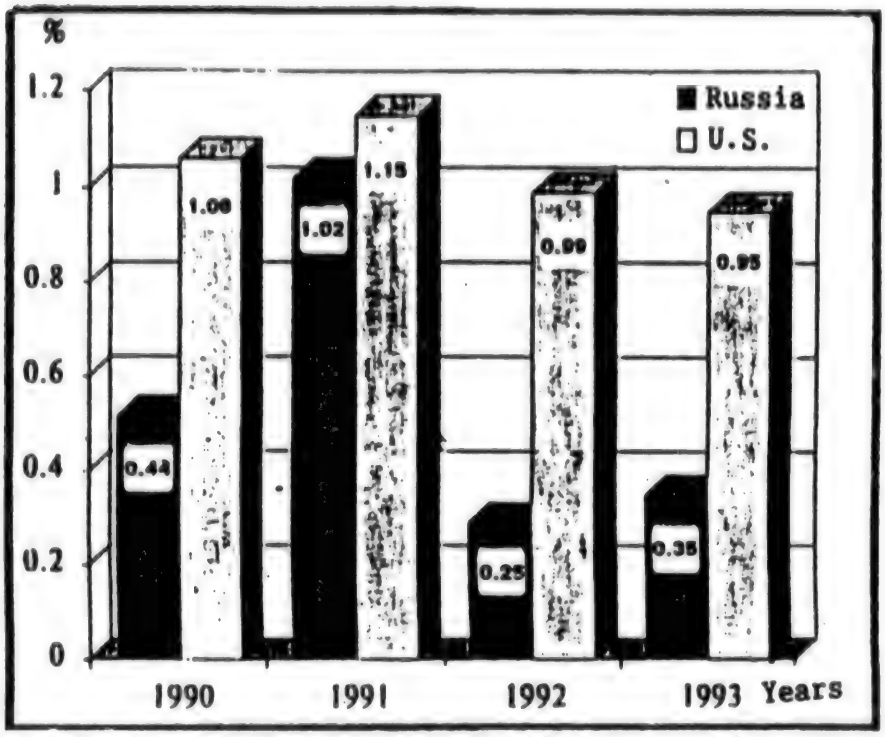
Today in Russia, there are three television channels in operation. But a resident in any other civilized country can get 16, 20, 30 channels. In order for our television viewers to have those same opportunities, several space-based complexes are being developed to replace Gorizont and Ekran. Slated for this year already is the launch of a special space vehicle in the GALS project (later, it will be called GALS-R). The launch of five or six such vehicles will not only provide an additional three or four central channels, but will also enable the operation of regional systems, which will expand the possibility of TV considerably.

Second, Gorizont is used today in an orbital grouping of communications systems. It is in 10 orbital positions and covers our entire country. It makes possible 6,000 main-trunk telephone channels. That represents 4.5-5 percent of the total number of channels, and there aren't that many channels. The new satellite will have a traffic capacity that is three times as large. And "right behind it" is another satellite, which is being built with Canadian firms and is on a par with world standards. With an orbital working life of 10 years and a traffic capacity an order of magnitude greater than its predecessors.

Near-term plans include the creation of a system for controlling freight traffic with satellites. With that, the movement of any container will be under ever-vigilant supervision.

[EKONOMIKA I ZHIZN] Today, some leaders have the impression that they're waiting for us on the world space market with open arms? How true is that? And what can we actually enter that market with?

[Koptev] We can integrate with the world space market in the framework of large projects only. Today, even in the United States, which spends more money than anyone else on space, there is a shortage of state financing. The new U.S. administration has placed an extremely large program in doubt—the creation of its own orbital station—because of the enormous expenses of upwards of $30 billion. The Europeans are well aware that, alone, they will not be able to build such a station. Some 32,000 people work in the space program in 13 countries of Europe. And every country, every firm is trying not to lose a single job. That is why, if they come to us, it's just to find what will help them advance their own project or



Percentage of state (or federal) budget of Russia and the United States represented by spending for civilian space programs

to work with us to do some large project. But that—and I emphasize this—is in the context of complementing each other, not replacing each other.

As for the "purchase-sale" thing, yes, we are aware of instances in which products or technologies that are worth hundreds of millions of dollars go for a song. And no good intentions with regard to interests of staff can justify officials in the unpardonable sell- off of our national property. We have to collaborate and trade, but we must not forget the interests of Russia.

[EKONOMIKA I ZHIZN] And yet, the aerospace sector last year had considerable losses.

[Koptev] Yes, we lost 30,000 engineers and 40,000 workers. The average wage last year was 4,200-4,700 rubles [R]. And that's in an extremely complex, specific sector where every operation, every bit of work done is something someone is held responsible for if a contingency situation arises through the fault of the person who did the work.

What's the answer? Right now there are a lot of conversations about structural reorganization and about conversion. We have studied the state of affairs very carefully and have reached this conclusion: if Russia wants to preserve its capability for space activity, it must perform a structural reorganization within the sector.

The gist of that reorganization is as follows. In the next 7-10 years, the national "pie" or the part of it doled out to us isn't going to be enough to go around for all those who were involved in the rocket-space sector in the past. That "pie" has become different for us. For example, the spending for military missile hardware is shrinking like shagreen. So to "spread" the money thin that is allotted for everyone signals nothing more than a dead-end. Within two or three years, we would be able to neither develop nor manufacture any new hardware.

We see the salvation of the sector in bringing together the 35-40 elite enterprises that have the most experience and that have built up excellent staffs that work at modern testing and production facilities, and then commissioning those enterprises to perform the major tasks. But until the questions of the forms of ownership are resolved, the state must give them the opportunity to exist and to work on space projects. In the process, they must be guaranteed work that represents at least 70 percent of their normal workload.

I must confess that the only people working at those enterprises today are those who, from the standpoint of market economics, are perceived as people who have been, as it were, "toasted to." Yes, they're stuck to their business, they're faithful to it, and they don't think about anything outside that realm. But we will lose two or three years, and those wonderful, competent, talented people will leave, and then it will be impossible to save the space program! After all, we have the cream of the crop at our enterprises, as does the rest of the world. If Russia can keep those people, she will be able to look to the future with optimism.

[EKONOMIKA I ZHIZN] Yuriy Nikolayevich, we are talking with you now on the eve of Space Program Day. Where did the news of Gargarin's flight find you?

[Koptev] At the Moscow Bauman Higher Technical School. After the TASS report, classes stopped, and we all ran to Red Square. Those who were there remember what euphoria reigned. Of course, it's a day we won't forget.

But for me, the day of 4 October 1957 is dear. For some reason, we don't think of that date with, in my opinion, the proper respect. But on that day, mankind took a step into a fundamentally new state, a step from theory to practical space. Life goes on, and we somehow grow accustomed to feats—scientific feats, design feats—and we forget about what was actually done. But you have the first landing on the Moon and on Venus, the first photos of other planets. All of them firsts!

But of course, nothing can compare with 12 April 1961 and its emotions. And I'm happy that that day belongs to us, that it was Russia that wrote it into the history of mankind.

West Seen Still Blocking Russian Access to Space Market

937Q0129A Moscow SEGODNYA in Russian
No 13, 4 May 93 p 9

[Mikhail Chernyshov: "Loss of an Opponent Forces the Americans to Reassess Space Tactics"]

[Text] The inoperative Russian Energiya superbooster in theory could bring our country an income of two or three billion dollars if the American National Aeronautics and Space Administration (NASA) decided to use it in constructing the Freedom orbital station. The possibility of such cooperation is now being discussed by American and Russian specialists. Why do the Americans have need of their former rival?

A little less than ten years ago the Reagan administration announced the beginning of the commercial space era. It was decided to proceed to the designing of a "celestial factory." The fabrication of pharmaceuticals, semiconductors and ultrastrong metals in this factory was proposed. At the same time it could serve as a workshop for the repair of satellites, an intermediate base for interplanetary flights and even a hotel for space tourists.

In addition to all else, the Freedom provided new jobs in the American aerospace industry and provided a load for the Shuttles—the American multiply reusable ships. The project was conceived on a large scale. The first stage of construction alone would require 8 billion dollars. It was proposed that the first units would already be assembled by 1992. The Americans continued to praise the creators of the Soviet Salyuts and Mir. They knew that the USSR was on the threshold of creation of a new-generation orbital station. Whereas the first orbital laboratories were assembled from 20-ton units (making use of the Proton booster), the Energiya ensured a fivefold increase in the payload and accordingly useful volumes and areas. Just one module of the Mir-2 station would be comparable in its capabilities to the entire Mir station now in operation.

In order to reduce the burden of financial expenditures the United States drew its traditional partners, the European Space Agency, Canada and Japan, into work on the Freedom. And although the times set for construction of station elements quite frequently were not met, in general the work proceeded on schedule.

The situation changed radically after Soviet cosmonautics dropped behind. The disappearance of its single competitor forced America to question the need for implementing such an expensive project. The mentioned 8 billion dollars have already been spent. But the total sum of expenditures now promises to exceed 30 billion. The Clinton administration, not feeling any enthusiasm about this situation, instructed NASA to reduce the cost of the project by two-thirds.

But at this point NASA and its partners remembered the Energiya. The delivery of station units into orbit by this booster in any case would be much cheaper than Shuttle flights. But, it goes without saying, each space vehicle is unique. The station modules with respect to size and other characteristics must be rigorously matched with the boosters, but for understandable reasons they do not by any means meet these requirements. In short, if a matching of Freedom elements with the Energiya in actuality is required, this will require great design modifications and tests. That is why a so-called "East-West Scientific Space Center" agency has already been established, intended in one way or another to coordinate research on the matchup of project elements. The Russian reader will possibly be interested in learning that the center is headed by Academician Roald Sagdeyev, who at an earlier time had been in the United States. True, it is incomprehensible why it is precisely he, Sagdeyev, known as a theoretical physicist, never having had anything to do with manned cosmonautics.

But the principal difficulties are not in technology. In former times the United States organized what was found to be an extremely effective agency: the Coordinating Committee for the Control of Exports to the Socialist Countries (COCOM). This agency, formally bringing together almost all the Western countries, but in actuality completely controlled by the United States, for decades blocked the entry of our cosmonautics into the world market. It is possible to mention at least ten very important contracts between our country's cosmonautics and American, European, Indian and Australian companies which have been broken, sometimes already in the final stage, by the COCOM.

The only exceptions, perhaps, are some international manned flights carried out on a commercial basis. But these sporadic earnings, ten or even less million dollars, are not adequate for maintaining Russian cosmonautics.

According to calculations by the Russian Space Agency (RSA), during the current year 48-50 billion rubles (in the prices of 1993) are needed from the state budget just to maintain an acceptable level of its activity.

The pronouncements of Russian space leaders at all times reveal some strange mixture of complete confusion and incomprehensible optimism. On the one hand there are cries of despair: one-third of all the highly qualified personnel have been lost, their leakage from enterprises is continuing, the wage level is below any admissible standards. Factories and design bureaus are lying idle, there are no orders.

On the other hand... Already in the immediate future, declares Yuriy Koptev, general director of the Russian Space Agency, Russian cosmonautics will be able to earn, just from foreign commercial projects, 200-300 million dollars per year. One must ask, from where will these millions come?

Russia, writes the Western press, is dumping space technology onto the world market. It is proposing that the South African Republic launch satellites from the African continent using its mobile rockets at a cost of 10 million dollars per launching (Western prices—40 million). The Energomash NPO is striving to interest American companies in their rocket engines, offering them at prices considerably below the world market. We are ready for everything. But even the most drastic dumping will afford virtually no chances for breaking through the COCOM barrier.

At the meeting between the presidents of Russia and the United States it was articulated, true, in passing, that Russia would be helped better not by credits, but by giving access to the world market for its best- developed technologies. The idea is not new. It is understandable that only political decisions at the highest level are really capable of opening the way for such projects as the Energiya-Freedom project. But, indeed, neither the United States nor other members of the "Big Seven" ever forget, first and foremost, their own interests. Are they ready to meet Russia halfway?

Controversy Over Variants of Law on Cosmonautics

Legislative Specialist's Version of Events

937Q0127A Moscow NAUKA I BIZNES in Russian No 8, 12 Mar 93 pp 9, 10

[Article by Svetlana Omelchenko: "Law on Cosmonautics: The 'Fraud' in the Alternative Version"; first paragraph is source introduction]

[Text] **But it's according to the established order. On 3 December of the past year, B. Yeltsin sends to the Russian Federation Supreme Soviet Commission on Transportation, Communications, Information Science, and Space his remarks on the draft of the Law on Cosmonautics, which, according to the reports of specialists, are quite sensible, indicating an in-depth study of the question. Then on 25 December, he unexpectedly introduces an alternative bill for review. How and from where did the president get the new bill over that three-week period? It's almost like a detective novel, and, in my view, it's flawed by only one thing—the absence among the characters of what writers of the famous genre call motive. But there's no doubt that the characters are concerned exclusively with the good of the state.**

A little background first. Recall that in the United States, the law on astronautics appeared long before the launch of the first artificial Earth satellite. But we, under the wholehearted reign of the administrative-command system, had no particular need for such a law. The relationships between science and industrial enterprises, as well as between the people working in that sphere of public life (by the way, there are about a million of them now, and with service personnel and family members, they number 10 million), were regulated by administrative acts, commands, and orders like no other place. The need for a law became clear when we entered the international space-products market, when it became clear that it would be difficult to conduct trade and set up relations with other countries without some kind of normative acts. The first to declare the need to develop and adopt a law on cosmonautics was the prominent specialist in the field of international space law, V. Vereshchetin, who had written an article on that subject in PRAVDA back in 1977. The first version of a law on cosmonautics was developed in the early 1980s by the USSR Academy of Sciences Institute of State and Law. An attempt to have it reviewed by the USSR Supreme Soviet was unsuccessful because of, as they say, the deficiencies that flawed the text.

The command-administrative system tumbled, and it became patently obvious that a law was the only way to set up relations among the plethora of juridical and physical persons that sprang up suddenly and that became—even for themselves unexpectedly—independent, if, as before, if not more so, dependent on one another and, often, deprived of state guardianship and support.

In August of this past year, Vice-Premier G. Khizha commissioned the Russian Space Agency to work on a draft of the law. I won't bother with the agony of creative genius in which—through the efforts of specialists from the agency, the Ministry of Defense, the Ministry of Foreign Affairs, the Russian Academy of Science, and that same Institute of State and Law, plus the Ministry of Science—a document that takes the realities of our time into consideration was born. On 24 October, proposals for a draft of the law were presented to the Russian Federation Supreme Soviet Commission on Transportation, Communications, Information Science, and Space. Based on that document, as well as a great multitude of others, a bill was prepared that, according to the official procedures, was sent around to the committees and commissions, as well as to the subjects of the federation

and to the president of the country. The same bill for which, on 3 December, Boris Nikolayevich [Yeltsin] prepared his remarks.

It's also worth noting the parliamentary hearings at which deputies were presented with the new bill and in which, without exception, the directors of all interested ministries and agencies took part and expressed their desires on the matter. Those hearings took place almost two months ago. And on 3 March, at a meeting of all those same directors, gathered by a parliamentary commission, a text was presented that had been prepared on the basis of all the reports that had been made.

So where did the alternative draft come from that was introduced at the president's initiative? What were the merits of that document that forced B. Yeltsin to use his ukases to violate the standard procedures for legislative initiatives and bypass even the State Legal Administration? (His director, R. Orekhov, announced officially to the deputies that the president's people hadn't seen the document that was in the [State Legal] Administration, or if they saw it, they hadn't signed it.)

V. Postyshev, candidate of juridical sciences and chief specialist of the Supreme Soviet Commission on Transportation, Communications, Information Science, and Space, commented on that strange story. He showed a paper addressed to B. Yeltsin and signed by the president of the Russian Academy of Sciences, Yu. Osipov (a compatriot of Yeltsin, by the way). Yuriy Sergeyevich [Osipov] hadn't even used Russian Academy of Sciences stationery. So, what was it, a private letter? It contains, according to V. Postyshev, disinformation. Defending the old draft somewhat reanimated a decade later, Yu. Osipov reports to B. Yeltsin that it hadn't been discussed in the commissions and committees of the Supreme Soviet.

"According to the law," explains V. Postyshev, "discussion of all the papers that go to committees and commissions is not necessary. It's physically impossible. A lot of clever people write things. Nevertheless, this draft was discussed and even sent to an advisory council in the Institute of Legislation and Comparative Law in the Supreme Soviet and to the juridical department of the Supreme Soviet. And here were their advisory actions. As you see, they were crushing.

"Furthermore," continues Vladimir Mikhaylovich [Postyshev], "the letter, in referring to the opinion of the interdepartmental expert commission on space (Yu. Osipov is its chairman), says that 'passage of the Law on Space Activity in the form in which it is formulated in the new draft, is unacceptable.' I personally spoke with commission members and with Science Secretary A. Bogdanov and explained that the interdepartmental expert commission expressed no such opinion on the matter."

"The draft doesn't specify the jurisdiction of the agencies of state authority..." But that's for the Constitution, not this particular law. "It doesn't establish the procedure for adopting the state space program..." But that question has been fully resolved, and there's no need for additional regulation. You just have to know the existing legislation and apply it intelligently.

So, need we continue?

V. Postyshev says that he personally, with documents in hand, was able to convince the president of the Russian Academy of Sciences that he was wrong. In reply, Yuriy Sergeyevich [Osipov] complained that he was tripped up by people whom he believed—the deputy director of the Institute of State and Law, V. Vereshchetin, and the chairman of the council of the no longer existing Interkosmos, V. Kotelnikov. It turns out that he, an academician, led the president of the country astray. Thus, now at least it's known what served as the reason for the legislative initiative of B. Yeltsin. Essentially, a private letter.

The alternate draft has been introduced for review. What about its authors? Are they celebrating a victory? At the 3 March meeting in the Supreme Soviet, they spoke out unequivocally. Not relying simply on my memory, I'll quote the record of the address by V. Vereshchetin: "Now it (the draft) is somewhat obsolete, because no one has done any work on it for about a year(!)... Because of that, I will not say anything about the draft..."

Here's what V. Kotelnikov said: "It's very good that the committee (on transportation, communications, information science, and space) has set out to draw up a new draft and that the Supreme Soviet has decided to review it..."

In fact, both acknowledged the flaws of their brainchild and abandoned any further fight for it.

V. Postyshev said that the president of the Russian Academy of Sciences, after meeting with him and agreeing to close the matter down amicably and to clear himself with B. Yeltsin about the obvious "fraud," asked for help. A compromise text was prepared.

"So that Yuriy Sergeyevich wouldn't be too ashamed to explain things to the president," says V. Postyshev, "I persuaded deputy A. Adrov, the head of the Supreme Soviet commission, and the director of the Russian Space Agency, Yu. Koptev, to also sign the document. Both agreed, but Yu. Osipov changed his mind at the last minute. He reported his refusal by telephone through his secretary.

Omelchenko: What are the consequences of all this?

"The bill the president came out with was drawn up in violation of the Constitution," says V. Postyshev. "Political opponents can accuse the president of attempting to redistribute the jurisdiction not only between legislative and executive authorities, but also among the subjects of the Federation. It's hard to imagine what Tatarstan, Yakutiya, and Altay—regions where enterprises of the space complex are located and where rocket hardware is

located—will think of that document. They have already gotten a concept and a version of the bill, and they have already sent reports with thanks for consideration of their remarks. A whole bunch of professional and political questions come up."

The Supreme Soviet commission nevertheless feels that it must follow the law strictly, i.e., bring both versions under review. A great deal of time has already been lost.

At a meeting in the parliament, a certain ticklish circumstance has come up unexpectedly: the Institute of State and Law, one of whose directors is V. Vereshchetin, signed a contract with military-space forces to develop a draft. Money was taken, but the product issued was no good. Naturally, they're uncomfortable about that and would like to redeem themselves somehow. But won't the attempt to save face be too high? At last, if there's no logic to all this, at least there's some kind of character with a motive.

Reply by Institute of State and Law Deputy Director

937Q0127B Moscow NAUKA I BIZNES in Russian No 9, 9 Apr 93 p 9

[Article by Prof. Vladlen Vereshchetin, doctor of juridical sciences, deputy director of the Institute of State and Law, Russian Academy of Sciences: "Problems on the Ground With Space Law"; first two paragraphs are source introduction]

[Text] **Issue No 9 of NAUKA I BIZNES (12 March 1993) printed an article titled "Law on Cosmonautics: The 'Fraud' in the Alternative Version," in which the process attending the birth of the law on space activity was seen through the eyes of our correspondent Svetlana Omelchenko and chief specialist of the Russian Federation Supreme Soviet Commission on Transportation, Communications, Information Science, and Space Vladimir Postyshev. Today, we are printing a reply to that article, by the deputy director of the Institute of State and Law of the Russian Academy of Sciences, Prof. Vladlen Vereshchetin, who sees the process in the completely different light. We, however, hope that the differences between such respected organizations as the Supreme Soviet committee and an Academy institute will not delay the passage of a bill so needed by the Russian space program.**

We will certainly keep the readers informed about the fate of that bill.

For many years now, the Russian Academy of Sciences Institute of State and Law, in which the country's only research group on space law works, has vigorously supported and still supports the adoption of a fundamental law on the regulation of space activity. The institute's staff developed and published the initial draft of such a law. However, contrary to the assertions of V. Postyshev, that was not in the early 1980s, but in mid-1991 (see the journal SOVETSKOYE GOSUDARSTVO I PRAVO [Soviet State and Law], 1991, No 7). That draft was never reviewed and declined by the USSR Supreme Soviet.

V. Postyshev declares that that very draft, "somewhat reanimated," was introduced in the Russian Federation Supreme Soviet by B. Yeltsin "a decade later!" In fact, in December 1992, the president introduced into the Supreme Soviet not the draft prepared by the Institute of State and Law, but a draft on which a group of experts from the country's main organizations involved in space research had, at the president's direct request, worked for several months in the first half of 1992. It's hard to understand why V. Postyshev and the article's writer found it reprehensible that the presidential draft included a whole array of tenets that had been proposed earlier by the Institute of State and Law.

But let's return to the historical and factual side of the problem. The 20 August 1992 draft that had been drawn up at the request of the president was sent to the Russian Federation Supreme Soviet and the president to be signed by the directors of the Russian Space Agency, the Ministry of Defense, the Academy of Sciences, and the Ministry of Foreign Affairs. Well informed on all that was V. Postyshev, who was present at one of the meetings of the group of experts as a staff member of the Supreme Soviet apparatus, but who then refused to participate in any further work by the group. The scornful remarks of V. Postyshev cited by the article's writer—i.e., that "discussion of all the papers that go to committees and commissions is not necessary. It's physically impossible. A lot of clever people write things"—refers to that draft. But, he asserts, that draft was discussed and drew "crushing" advisory actions. Allow me to say quite definitively that no one informed the Academy of Sciences, as one of the developers of the draft, of either the discussion of the draft or of the content of any advisory actions. There was no such open, public discussion of the draft with the developers, who represented the main "space" organizations.

I see absolutely nothing wrong with the fact that, as the article's writer says, about two months later, the Supreme Soviet Commission on Transportation, Communications, Information Science, and Space was presented with another draft, the development of which was apparently assigned to the Russian Space Agency. But I do see something wrong with something else. Instead of an open discussion and comparison of the existing drafts, with an invitation of all interested parties, instead of a determination of the strengths and weaknesses of those drafts and, ultimately, an attempt to combine them and prepare a legally sensible and good document, the efforts of the people who were assigned to organize that work in the commission were directed at initially hushing up the existence of the "interdepartmental" draft, and then discrediting it. Is that to be considered the normal procedure for preparing a bill on an issue that is so important to the country?

As for the draft that was sent around in several versions from the Supreme Soviet Commission on Transportation, Communications, Information Science, and Space, the Institute of State and Law twice—in October and November 1992—issued extensive, article-by-article conclusions in which it noted the principal flaws in that draft and the legal work the draft still needed. But the remarks of the Institute and of a number of other organizations were, as a rule, ignored, and the draft was introduced for review into the Presidium of the Supreme Soviet. In that context, Academician Yu. Osipov, as chairman of the Interdepartmental Expert Commission on Space, apprised B. Yeltsin of the situation that had come about and of the absence of any movement in the review of the draft law prepared at his request and especially that the formal basis for the refusal to discuss the draft in the commission was, essentially, a reference to the absence in the ministries and agencies of the right of legislative initiative.

I think that if there is now the desire and the good will, a qualified group of experts can still be created who would represent all the interested parties; the group could try to draw up a single draft that satisfies the interests of the country.

And finally, one last thing. After setting out to find the root motives of the actions of the staff members of the Institute of State and Law, the writer of the article made what seemed to her a sensational discovery: the Institute of State and Law allegedly received money from Russian military-space forces to draw up the law. In a spirit and style that are completely in step with the article as a whole, it is further reported that "money was taken, but the product issued was no good." I am thankful to the writer of the article at least for the fact that she didn't accuse me or the institute of taking money from the American military-space forces or the CIA. As for the military-space forces of Russia, they can, I have no doubt, confirm that they never placed an order with the institute to draw up a draft of the law on space activity for any money or for free. As it is, there was absolutely no need for that, because experts of the Ministry of Defense and representatives of the other interested ministries and agencies took an active part in the development of the draft that is now being called the president's draft. By the way, no matter how much V. Postyshev assures us of the opposite, that draft was drawn up in total compliance with the requirements of the Constitution and with the interests of the subjects of the Federation.

The interview with V. Postyshev gives the scientific community disinformation on the path taken in the preparation of an important Russian law.

Major Reorganization, New Director at NPO Molniya

937Q0125A Moscow KOMMERSANT DAILY in Russian No 74, 22 Apr 93 p 2

[Unsigned article: "Aerospace Firm Intends to Live by Market Laws"; the first paragraph is an introduction]

[Text] The well-known Molniya aerospace company, which developed the multiply reusable Buran ship, is entering into a period of radical transformation of its structure and economic strategy. Yesterday the State Committee for Industrial Defense Branches confirmed a new general director of this scientific production association. Aleksandr Bashilov, former chief engineer of the Molniya company, became the new director. He is proposing a new concept for company development oriented on survival under market conditions. The program provides for establishing economically independent subdivisions combined into a state aerospace company. Mr. Bashilov feels that in the near future the export of a business aircraft developed by the company may bring in the greatest profit.

The Molniya enterprise of the former Ministry of the Aviation Industry was established for developing the multiply reusable Buran spaceship. The general director of the firm, from the moment of its founding, was Gleb Lozino-Lozinskiy, who earlier directed work on the space aircraft constructed by the MiG company. Up to 1986 the operation of the Molniya was financed on a priority basis because there was no doubt as to the feasibility of constructing the Buran. The Molniya honorably executed its mission, it constructed the Soviet Space Shuttle, but the economic situation in the country has changed.

During the last three years state orders for military-industrial enterprises were reduced by 60 percent and work on new programs ceased. The Molniya firm was in an especially difficult situation because it had a quite narrow specialization. As a result of the financial problems of the enterprise, in February 1993, on the basis of a resolution of a general assembly of enterprise specialists, the Committee for Industrial Defense Branches terminated the employment contract with the general director Mr. Lozino-Lozinskiy. The assembly also decided to work out a program for bringing the enterprise out of its crisis and to select a new director. As a result of the voting Aleksandr Bashilov became the new director.

The ideas of the new director are oriented on a direct commercial purposefulness of most of the programs and a partial decentralization of enterprise control. The forming structural subdivisions of the association are being given a higher degree of independence. At this moment the degree of this independence and the method for its juridical embodiment have not yet been finally determined. The company will be directed by a board of directors which will include representatives only of those subdivisions which are yielding a real profit (a fixed part of the profit will be allocated to a fund for the stabilization and development of the company).

The central company will be the holder of the fixed assets and structures for whose leasing all the remaining subdivisions will conclude agreements. The search for orders, it is assumed, will be undertaken by both the board of directors and by the subdivisions. The central

accounting office of the company will handle business with the taxation and state budget authorities.

During 1993 state financing will support about 40 percent of the enterprise's workload (military orders and maintenance of the Buran program), but the remaining resources will be directed to the most promising commercial programs: minifactories for the reworking of agricultural products and producing equipment and tools, based on high-technology developments of the enterprise. Mister Bashilov feels that the most promising commercial program of the enterprise may be the export of the Molniya-1 business class aircraft, developed at the enterprise, which Western experts have highly rated. The standard production of the aircraft has now been assigned to the Samara Aviation Enterprise and negotiations are in progress on its export to one of the European countries.

Ukraine Seeks to Develop Independent National Space Program

937Q0124 Kiev VECHERNIY KIYEV in Russian 10 Apr 93 pp 1, 4

[Interview with Vladimir Pavlovich Gorbulin, general director of the Ukrainian National Space Agency, by Vladimir Chikalin, under the rubric "12 April—International Aviation and Space Day": "Ukraine Will Be a Modern Space State"; first paragraph is source introduction]

[Text] The calendars are all wrong—grieved one of the literary personages created in another century. But what then can be said about our time, whose events all the calendars fail to keep pace with. And yet, there are dates that are not subject to all those who compile them. Among them is 12 April, the day on which a man from Earth first overcame its gravity. And no matter how much we refuse to have anything to do with the former USSR, Yuriy Gagarin was nevertheless a citizen of that state. That is, as they say, a truth that nobody will rewrite, and they certainly won't scratch it out. But there's also another truth. And it is that Ukraine did a great deal for the first space launch. And today, as it sets up an independent state, it is also creating its first space programs. And that's the very topic of our conversation with the general director of the Ukrainian National Space Agency, Vladimir Pavlovich Gorbulin.

[VECHERNIY KIYEV] Vladimir Pavlovich, when was Ukraine's first space agency created?

[Gorbulin] The Ukrainian Space Agency was created by the presidential ukase of 9 March of last year.

[VECHERNIY KIYEV] Can that day be regarded as the holiday for the Ukrainian space program?

[Gorbulin] I don't think so. Because the first space flight, on 12 April, is also our holiday. Because back then, many firsts in space-related science and applied programs already belonged to Ukraine. Never mind that at the time, it wasn't customary to single out the contributions made by each republic. But today, we can say that the scientific-technical and production contribution of Ukraine to the development of the space program is very great.

[VECHERNIY KIYEV] And because today it's in a position to handle its own problems in the field of space. But if we get down to specifics, what is the space agency of Ukraine working on today?

[Gorbulin] Primarily on the drawing up of science programs involving the use and testing of space hardware, the creation of the foundations of legislation in that area, the financing of those legislative foundations, and the search for money, including foreign investment. We're doing everything we can to make Ukraine a space power. And to do that, we need to convince the world that we have all the capabilities to be a space power. Even now, Ukraine as a space state is something like third place in the world. And that's at a time when, with the breakup of the USSR, Russia essentially became the legal heir to everything that had been created in the field of space. And yet our scientists and producers did so much to set up and develop the Soviet space program. Take just the Dnepropetrovsk quadrant, where the space shield for the USSR was created.

[VECHERNIY KIYEV] Vladimir Pavlovich, if we can get down to specifics, what are the tasks that the space agency is dealing with first?

[Gorbulin] We are primarily trying to see to it that Ukraine has its own space physiognomy. Today we need to be creating our own infrastructure for executing space programs. Take a problem like creating a system for controlling satellites. There are three control stations in Ukraine, but we need a special center. So the creation of an infrastructure system—that's our highest priority job.

[VECHERNIY KIYEV] Does the program include the creation of your own space launch facility?

[Gorbulin] It doesn't call for the building of one, because there's no need for one. A group of Ukrainian legislators recently visited the Baykonur space launch facility. There we met with the general director of the Kazakh National Space Agency and with the specialists who work there, and they all said the same thing: "Baykonur is open to the Ukrainian space program."

[VECHERNIY KIYEV] By the way, Vladimir Pavlovich, Ukrainian legislators were present for the liftoff of the Zenit launch vehicle, which was developed and built in Ukraine at the Yuzhnyy Machine Building Plant. Tell us about the rocket in detail.

[Gorbulin] That rocket can lift space vehicles weighing up to 15 tons into near-Earth orbit. But its chief merit consists in the automated system for preparing it for launch. Those preparations take little time, whereas the preparations for other rockets take months. Our Zenit is

the most ecologically clean rocket. It operates on kerosene and oxygen, which keeps the environment intact. Foreign specialists, especially the French, who were present at its launch, consider our Zenit the launch vehicle of the 21st century. But we are also aware of its shortcoming: for now, it cannot lift vehicles into the geostationary orbits in which communication satellites "operate." Which is why it needs one more stage, which our designers are working on right this minute.

[VECHERNIY KIYEV] And will Ukraine have its own cosmonaut corps?

[Gorbulin] Manned flight is a very expensive pleasure. When you send a man into space, you have to have a clear idea of just why it's necessary. In the past, many missions were more for the purpose of propaganda, more for politics. But in theory, when the Zenit launcher is capable of putting manned stations into orbit, that's when we'll look at the question of training our own cosmonauts.

[VECHERNIY KIYEV] Are there any plans to launch Ukrainian satellites into space this year?

[Gorbulin] No. Our Zenit rockets this year are fitted for executing Russian Ministry of Defense programs. But in 1994 we plan to launch a satellite that will be handling tasks that will be in the interests of our country.

[VECHERNIY KIYEV] Vladimir Pavlovich, how much will the Ukrainian space program cost?

[Gorbulin] We requested 36 million Ukrainian rubles. Is that a lot, or a little? In our view, that will be just enough to keep the budding Ukrainian space program from dying. Calculations show that if the financing of space programs were ceased for just one year or it the programs were cut back to a critical level, our state would fall hopelessly behind all the other countries. And to catch them would take years and, most important of all, huge amounts of money. Everyone is well aware of that—Prime Minister Leonid Kuchma, the finance ministers, the economists, the people's deputies who visited the Baykonur facility on the eve of the approval of the national space program. Ukraine has unique space personnel and a production potential that will make it possible to make Ukraine a great space country. And I am certain that Ukraine will become one. We will strengthen our collaboration in the field of space with the CIS countries and will actively participate in the execution of programs in the framework of Interkosmos.

[VECHERNIY KIYEV] And will the space program work for the defense of Ukraine?

[Gorbulin] Our program has a dual purpose. Ukraine as a space state has the right to develop satellites that can perform both verification and inspection. We are working with the Ministry of Defense on those areas. But in my view, in that department the role of space in the handling of defense tasks has not yet been fully clarified.

[VECHERNIY KIYEV] And the last question: how did you end up in the space agency of Ukraine?

[Gorbulin] My entire life after graduation from the institute in Dnepropetrovsk has been linked to work in the area of space. I spent many years working in a design bureau that was developing launch vehicles and in the Cabinet of Ministers; I'm a candidate of technical sciences, and I'm working on my doctoral dissertation. There's practically no rocket system in whose development I haven't taken part in. So everything that has anything to do with space—that's my life. And I'd like to take the opportunity to wish everyone who is involved in the space program a happy holiday, this International Aviation and Space Day!

Ukrainian Space Program Looking to Baykonur as Launch Site

937Q0123A Kiev URYADOVYY KURYER in Ukrainian 3 Apr 93 pp 1, 5

[Article by Volodymyr Ilchenko under the "Ukraine's Priorities" rubric: "Baykonur Facing Dilemma (Ukraine Space Agency Has Developed Space Exploration Program That Is Impossible to Implement Without Operating Cosmodrome"; photos by Stanislav Averkov]

[Text] Leninsk, the capital of the "star region" also known as Baykonur, is indeed a somewhat fantastic, "otherworldly" town. And not just because, in the words of a space classic, the way to stars has been paved through the town, - one will not find the town on a regular map. To be more precise, a map has as many as five settlements with the same name, but none of them has anything to do with the cosmodrome.

But in everything else it is quite earthly: narrow streets lined up as if following military regulations, neglected "Khrushchevka" apartment buildings, entire floors of abandoned apartments with boarded windows. Baykonur is in decay, and with it its "bedroom addition", the mocking name given to Leninsk by local residents. Less and less frequently the air is shaken by the thunder of a launched rocket.

Recently a Ukrainian delegation headed by Chairman of the Commission on Defense and State Security Problems Valentyn Lemeshev arrived here. It included General Manager of the Cabinet of Ministers National Space Agency of Ukraine Volodymyr Gorbulin and several members of the Parliament. The trip was organized by the Agency and was dedicated to negotiations with the Kazakhstan party regarding joint operation of the cosmodrome. And one more important event took place - a "Zenit" rocket built by Dnipropetrovsk scientific and production association "Pivdenmash" [also known as "Yuzhmashzavod"] was launched into space.

The Ukrainian delegation was received "at the proper level". It was met by the cosmodrome Commander, Major General Oleksiy Shumilin. The next stop was at the town's only prominent building - hotel "Baykonur",

where cosmonauts live before the launch and after landing. But the Baykonur schedule was such that only three to four hours were set aside for night sleep; the remaining time was spent at rocket launches, launch sites, installation and testing complexes and in negotiations and meetings...

On March 25 the Russian "Proton" was launched, and on March 26 - the "Ukrainian" "Zenit"; however, the State attribution is conventional, because both rockets had been built on orders from Union structures, in particular the former Defense Ministry. Although designers from KB [design bureau] "Pivdenne" do not like to openly praise their creation, one could feel their firm belief in its advantages over the "Proton". Their two-stage rocket puts into an Earth orbit an approximately 15 tonnes payload (the three-stage "Proton" can lift 20 tonnes), but "Zenit" is convenient for shipping and launch preparation. Its automatic system for fueling at the launch site makes it possible to fully prepare a rocket in 1.5 hours ("Proton" needs a two days preparation). The "Zenit" rocket launch complex is compact and does not use as much metal as is used for launching other types of launch rockets. A fairly slim-looking tower developed and built by Novokramatorsk Heavy Machinery Building Plant puts the 430-tonne giant to a vertical position. And the most important thing is that "Zenit" is an ecologically clean rocket. It uses liquid oxygen and kerosene rather than poisonous nitrogen compounds that drive other rocket engines.

So according to specialists' assessments this is the rocket of the nearest future. It is planned to develop a third stage for it, which will make it possible to put satellites into a so-called geostationary orbit. The future prospects are manned missions, according to what Yuriy Semenov, General Design Engineer of the "Soyuz", "Progres" and the "Mir" station that are well-known in the entire world, told the Ukrainian delegation.

"Space" designers are like poets - they live in their own worlds that are far away from Earth and often incomprehensible to mere mortals. While we were watching the railroad platform with the "Zenit" slowly move to the launch site, Stanislav Konyukhov, General Design Engineer of KB "Pivdenne" was enthusiastically describing a project of a manned flight to Mars. Implementation of these plans is possible around 2015-2020, but the work must begin now. Documentation development, a relatively "inexpensive" stage, will take four to five years; during this time the economic situation in Ukraine might improve and then the time will come to talk considerable investment.

For a rocket specialist a launch is a special event, with its own traditions, rituals and even superstitions. For instance, the designated launch time is considered a taboo not to be talked about, and not just due to "secrecy" considerations, but in order not to bewitch. But if a rocket has been launched successfully and in about 15 minutes brings its payload to space, all taboo "restrictions" are removed. Unfortunately, when the "Zenit" was going into the sky, low clouds above Baykonur prevented us from fully enjoying the beauty of the flight. A second - and the turned over climb only left behind thunder that took away our breath. And later, when we were hurrying to the launch site, we felt the warmth of metal parts of the launch system and a slight burning smell. A rocket is controlled from a deep underground bunker. Incidentally, a full-fledged underground town has been built at Baykonur. "We even have a subway here, like you have in Kiev", joked Bulat Dzhanasayev, Head of the State Defense Committee of the Kazakhstan Supreme Soviet. But only higher rank officers, those who had indeed "stuck" to their work, have stayed at control panels in the bunkers. Lieutenants and Senior Lieutenants who used to watch launch sites have left. Baykonur is losing its status as a promising place.

Nowadays it reminds one of a terminally ill patient. The 1988 launch of a multiple-launch spacecraft "Buran" was the last important achievement at the cosmodrome.

In the installation and testing building, where launch rocket "Energiya" that puts "Buran" into orbit is being assembled, we were greeted by Vyacheslav Falin, Deputy General Design Engineer of NVO [scientific production association] "Energiya". According to him the work on the "Buran" system had been given a big boost in 1985, when the American Space Shuttle performed a test diving into the atmosphere above Moscow and then went back up into space. This maneuver was opening broad opportunities for an attack, which the Soviet military space technology did not have.

"After that the CPSU Central Committee had directed all effort to the development of an appropriate weapon", explains V. Falin. "I can assure you that had it not been for the 'Buran' system there would have been no Reykjavik - the Americans would not have talked to us..."

V. Filin is speaking enthusiastically about advantages of "Energiya", a true space giant that can put into orbit a payload that weighs over 100 tonnes, but one can hear faint notes of regret in his voice.

"The boilers have failed, and temperature in the installation and testing building is dropping - this had never happened before. In the past we even used to count the number of dust particles per cubic centimeter - the thing is, if an organic material gets into liquid oxygen, there will be an explosion".

But in spite of all adversities two "Energiya" rockets are practically ready. Late this year or early next year one will be able to launch "Buran" into space. If only one has an order and hence the funds.

Ukraine too can be proud of this scientific achievement because about 50 percent of the launch rocket components and systems were developed and manufactured at our enterprises. In particular, side boosters are a creation of KB "Pivdenne" and Pivdennyy Machine Building Plant.

It is difficult to determine the exact share our country contributed to Baykonur and to space development at large. The delegation visited a military missile complex known as SS-18, which too had been developed and built in Ukraine. A stand at the military unit museum drew our attention - Leonid Kuchma's photo portrait was the centerpiece of the stand.

"'Pivdenmash' is a heavy-rocket manufacturer", explained our rocket unit guide. "The current Prime Minister of Ukraine was the plant Director, and we honor our vendors..."

Stanislav Us, Chief Design Engineer of military missile complexes for heavy rockets (incidentally, he is a Hero of Socialist Labor and Lenin Prize laureate) told us about military "virtues" of the missile that just recently had threatened the world. But if one discards all military tricks the designers imparted into the SS-18 (protection from a nuclear explosion, "elusiveness", impossibility to guess its flight trajectory etc.), the rocket can be used for scientific and business applications, for instance, for manufacturing drugs and other ultrapure compounds or elements, which can only be achieved in space in sufficiently high orbits.

The almost 40-year history of Baykonur is not just launches and celebrations of man's victory over space and a probable adversary. Our delegation had an opportunity to see the destructive force of missiles if their untamed energy is released inadvertently on Earth. At one of the launch sites there is a rock with the following inscription: "At this site on October 24, 1960, an accident happened during the first test of an intercontinental missile..." People, among them the then Chief Artillery Marshal Mytrofan Nedyelin, were working around an SS-7 missile. After the explosion about 100 people perished in the fire in a matter of several seconds, and one had not been able to determine identities of all of them. According to official information M. Nedyelin was killed during an aircraft test. Academician Mykhaylo Yangel, who also was at the site, had escaped by chance: he went behind a building to have a smoke. The very same date, October 24, three years later there was an explosion at another place. Since then this day is considered a mourning day at the cosmodrome, when no testing is done.

The site of the 1960 accident is still "dead", even grass does not grow around it. But then the entire Baykonur is gradually "dying" as a result of the great "accident" suffered by the former Soviet Union. The young are leaving the cosmodrome, and Leninsk population is dwindling. Property is being pilfered and sold to businessmen. In the past Baykonur was performing the functions of a superpower's cosmodrome - from there launch rockets were launched and manned missions started; finally, all strategic rocket complexes (up to the world's most advanced SS-18), of which the USSR had over 300, were launched from there. At present Baykonur with all its "stuffing" is Kazakhstan's property, while space troops that operate it are Russian. In Ukraine some people reckon: let Russia and Kazakhstan sort out their Baykonur issues - it is none of our business: what does our country need the space for when we are not able to properly manage on the ground. As the above mentioned V. Filin said, to explain the role of the space industry is the same as to argue the need to have electric power in a house. Nowadays the entire civilized world, even "Third World" countries, has gotten into the near space. Space means communications, TV and information about Earth surface and atmosphere; it also means new technologies and materials, and in the end space expenditures turn into profits. For instance, the "Soyuz-Apollo" program, into which the Americans had invested $16 billion, ten years later produced considerable profits exactly due to discovered technologies (think of Teflon frying pans and irons). The program of putting "Buran" into orbit has produced 80 new materials and 600 technologies. It is important to learn to make the best use of them. If, for instance, one covers a cattle farm with a 30 mm layer of material that keeps reservoir temperature at -253 degrees, then no heating would be needed. Liquid nitrogen, which made it possible to stabilize temperature at the Chernobyl AES and eliminate the threat of explosion, is also manufactured by the space industry. Space means constant search for innovation. After all, one can make business in space by launching "commercial" satellites with our rockets. Such proposals are already coming in. According to an "Australian" project Ukraine could be putting satellites into orbit from launch sites in Australia - there will be no difficulties in building them.

At present four agreements have been signed between CIS countries regarding cooperation in this area, particularly with the goal of joint utilization of the space infrastructure. Russia and Kazakhstan have already achieved certain agreements regarding Baykonur operation, and Ukraine too is interested in developing both three- and two-party relations with these countries. During the meeting of the Ukrainian delegation with the Parliament group of the Kazakhstan Supreme Soviet headed by B. Dzhanasayev that included the head of the country's National Aerospace Agency Tokhtar Aubakirov the parties agreed that space structures of the two countries would develop a proper agreement and present it to their governments and parliaments for consideration. The need to accelerate the negotiation processes is also due to the fact that a national space program has been developed in Ukraine; V. Gorbulin acquainted the Kazakhstan delegation with the program. It provides for the development of Ukraine's own network of design bureaus, institutes, enterprises etc. that would work for space, and for implementation of the interstate program of countries that signed an agreement in Minsk on a joint effort in the field of space research and utilization; it also provides for ties with other countries of the world.

For Ukraine to remain a space-developed country it is sufficient to maintain the S & T potential that has already been created there. In addition to developing all strategic missiles of the entire generation, our Kharkiv

NVO "Khartron" has developed a control system for a number of strategic complexes and spacecraft components. Ukrainian enterprises manufacture various types of equipment for them (side command radio lines, systems for recording and transmitting information about Earth, switching devices etc.). Our country is capable of manufacturing launch rockets and its own satellites, however, so far we do not have the ground infrastructure that would make it possible to acquire, decode and transmit to customers information from space. One must be creating such infrastructure today.

The program includes development of Earth satellite "Lybid", which has to solve certain communication problems. Another Ukrainian satellite must conduct remote Earth sounding and follow the status of soil, crops and rivers and the ecological situation. In order to launch these spacecraft it is necessary to improve the means of transportation, especially launch rocket "Zenit". It is impossible to realize these intentions without Baykonur, therefore Ukraine, while maintaining its space potential, must also make a contribution to saving this unique area.

Russian-U.S. Joint Enterprise to Market Electric Rocket Engines for Communication Satellites

937Q0122A Moscow KOMMERSANT DAILY in Russian No 31, 20 Feb 93 p 4

[Article by Mikhail Sergeyev: "Russian Satellite Engines Offered to Americans"; the first paragraph is an introduction]

[Text] The joint Russian-American enterprise International Space Technology, Inc. (ISTI) yesterday began negotiations on the sale of electric rocket engines for American communication satellites. Russian engines, successfully competing against similar American engines, can provide the Russian side orders worth several million dollars. The company Space Systems/Loral is engaged in the promotion of the Russian engines in the American market.

Commercial communication satellites—the most profitable form of space technology—must constantly have their antennas precisely oriented on the Earth. Chemical engines have been traditionally used for maintaining a rotating satellite in the necessary position, but their multiyear operation requires kilograms of fuel in whose place it would be possible to have additional communication apparatus aboard the satellite. Today economical electric rocket engines, operating with a lesser fuel expenditure, are making it possible to save weight. It is the opinion of specialists that the electric engines produced in Russia with respect to their technical specifications are superior to similar engines produced in the United States.

In order to promote their product in the Western market the developers of the electric rocket engines, the Moscow Applied Mechanics and Electrodynamics Scientific Research Institute and the Fakel Scientific Production Association (Kaliningrad), have organized with the American company Space Systems/Loral a joint enterprise known as International Space Technology, Inc. Within the framework of joint activity the Space Systems/Loral company is engaged in the development of electronics. Now the ISTI, in the name of the Russian companies, is conducting negotiations on participation in competitions for a better engine for American communication satellites. Should the ISTI win it will receive orders valued up to several million dollars. Specialists feel that the chances for success are very great. In the opinion of Harry Popov, ISTI director, the advantage of Russian items on the high-technologies market is attributable to the "inventiveness of Russian engineers and some foresight."

The engines which have been discussed are already operating on Russian communication satellites. However, the American side requires that the equipment undergo a full cycle of tests; contracts must be preceded by the testing of engines on stands in the United States and possibly flight tests on experimental satellites under the control of American specialists.

The Moscow Applied Mechanics and Electrodynamics Scientific Research Institute was organized in 1987 for research on the behavior of plasma in space and on the development of electric rocket engines. The plasma accelerator developed at this institute has already operated for four years on the Mir orbital station. The products developed at the institute also are being used for industrial purposes: the Dutch company Hauser-Holding BV is purchasing plasma accelerators from this institute for vacuum spraying apparatus.

Aerospace Conversion Center Created

937Q0122B Moscow NAUKA I BIZNES in Russian No 8, 5 Mar 93 p 11

[Article by Yuriy Stepanov and Andrey Yakovlev: "Conversion and Space"]

[Text] An Aerospace Complex Conversion Center has been established in Russia. The International and Russian Engineering Academies have been actively drawn into its work. In particular, they are engaged in developing the concept of a multisided approach to the process of conversion in the aerospace industry and use of the unique scientific-technical potential of Russia in the fields of rocket construction, cosmonautics and aviation.

The center intends to interact with international organizations for a more successful realization of economic, ecological and social programs. On their part the engineering academies already have proposed a number of priority joint research programs which will make possible effective use of the modern achievements of the aerospace complex.

Sardinia Chosen as Cosmonaut Training Site

937Q0122C Moscow PRAVDA in Russian 21 Apr 93 p 3

[Unsigned article: "Russian Cosmonauts Will Be Trained in Sardinia"]

[Text] Russian scientists together with their Italian colleagues have selected the Mediterranean island Sardinia as an ideal place for the training of Russian cosmonauts. A center for physical and psychological training for space flights will be organized in the neighborhood of geothermal springs in the southern part of the island, 30 km from Cagliari, the administrative center of Sardinia.

History of TsNIIMash Recounted

937Q0117A Moscow NEZAVISIMAYA GAZETA in Russian 13 Apr 93 p 6

[Article by Anatoliy Zak: "In the Space Cradle. History and the Present Status of the Central Machine Building Scientific Research Institute at Kaliningrad"]

[Text] Memorable dates and holidays always make one take a backward look. All this is entirely correct for Cosmonautics Day as well. However, turning back to the roots of the Soviet space program, today one must to a greater degree learn and discover than to remember.

Secrecy, which with the passage of time degenerates into unfavorable oblivion, surrounded not only the names of people and the creations of their hands, but also geographic places, and at times entire cities. This fully applies to that place where, it can be said without exaggeration, a Soviet rocket-space giant was born.

The special position of this city was evident to all, although in our encyclopedias under the entry "Kaliningrad, Moscow Oblast" there was mention only of wood-processing and textile industries. However, a completely different branch for many years determined the development of that city and its still unwritten biography is one of the most graphic illustrations of the history of the "technotron" age.

City With a Quiet Beginning

In 1929 Podlipki was a typical wooden out-of-the way place in the northeastern Moscow region when portly gentlemen in fur coats and with walking sticks, speaking German, suddenly began to appear in the streets. With their arrival the city began to change rapidly. On either side of the railroad station construction began on stone residences of a size unusual for the area. Factory buildings rose not far away. The German engineers and construction workers, and there were probably several thousand of them, did their work rapidly and without fanfare, in less than three years erecting an enterprise, modern for that time, where there had been nothing before. They disappeared in 1932 as suddenly as they had appeared. The factory had already begun to operate. It was assigned the number 8 and the "paper" designation was "imeni Kalinin." In 1938 Podlipki became Kaliningrad. The constructed factory produced artillery systems, and as we now know, this was only one of the numerous examples of questionable "cooperation" between the young Soviet republic and the growing claws of the German monster.

Ironically the fate of Kaliningrad in the Moscow region again experienced an "attack" of the Germans immediately after the war, but in this case in a completely different way. On 13 May 1946 a secret decree was issued by the USSR Council of Ministers marking the beginning of work on rocket construction in our country. It was decided that experimental production would be initiated on the basis of what remained of Artillery Plant No 8, evacuated during the war years. The new enterprise was designated NII-88 [Scientific Research Institute No 88]. Then numerous trainloads of parts of rockets, auxiliary equipment, volumes of documentation, blueprints and interned German rocket specialists arrived in Kaliningrad from Germany. The ticklish matter of the role of the Germans in the Soviet rocket program will long remain an open question, but in the words of one of the veterans of the space program, Yu. Maksimov, the role of the German legacy in the USSR technical breakthrough into the rocket era was significant.

Soviet designers had to master Germany technology in order thereafter to find their own way. These first steps into space were taken in 1946-1947 with the assistance of German hands and German brains.

Pursuing Our Own Way

Only five years after the founding of the NII-88, the V2 rocket, which had been assembled little by little and which had been mastered with such titanic efforts, was deemed hopelessly antiquated by Soviet designers. The cold war was at its height and rocket systems and entire generations of missiles sprouted like mushrooms after a rain. On 26 October 1950 the R-2 controllable ballistic missile was successfully launched from the Kapustin Yar test site and successfully flew 600 km. In contrast to the V it was outfitted with a so-called carried fuel tank. This design made possible a sharp reduction in the weight of the vehicle because the walls of the fuel tank simultaneously served as the rocket housing. On 2 April 1953 the R-5 rocket attained a strategic range, flying 1200 km after launching from Kapustin Yar. Finally, on 25 December 1956 a test copy of the long-range ballistic missile was successfully launched from aboard a submerged submarine. During this period organizations branched off from the NII-88, one after another; these were engaged in the direct construction and production of individual types of rocket-space technology. The NII-88 increasingly became the brain center, developing concepts on the development of rocket technology and carrying out expert evaluation of the projects of other enterprises. SKB-1 [Special Design Bureau-1], headed by S. Korolev, now the so well-known Energiya NPO, also located in Kaliningrad, was the first to branch off from the NII-88 in August 1956. Then followed separation of SKB-2, headed by A. Isayev, and SKB-3, headed by D. Sevruk.

By May 1960, when preparations for manned flights were already in full sway, on the grounds occupied by the NII-88 construction was completed on the first building of the VTs-88 computer center, from which it was planned that the Vostok spaceships would be controlled. Now this subdivision is called the Flight Control Center and to this day it is an integral part of the TsNIIMash.

From 1965 and up to the breakup of the Soviet Union the NII-88 was under the oversight of the Ministry of General Machine Building. So to speak, in order to bewilder the enemy, in 1967 the NII-88 was given a new name, which it still retains: Central Machine Building Scientific Research Institute [TsNIIMash].

Mockup of multiply reusable space transport system.

Glancing Into the Future

The landscape of the grounds of the TsNIIMash now outwardly fully resembles a typical industrial enterprise with numerous production buildings, pipelines and, as always, structures which have not been fully completed. However, precisely behind the walls of many of these faceless structures is concealed apparatus and equipment which over the course of more than 40 years has enabled the scientists here to predict the space future of our civilization. During these years the TsNIIMash in essence was transformed into a gigantic laboratory—a focus of the best scientific personnel and technical potential of the country.

Virtually all known Soviet boosters underwent initial debugging within the "crucibles" of the test chambers located here. However, these walls know other space vehicles as well. Their images do not appear in the books on cosmonautics with which we are familiar and their mockups and photographs are not to be found in open museums.

And today in the TsNIIMash dynamic tests building there is an enormous conical model of a rocket. This is a dynamic copy of the "N-1" booster, reduced by a factor of 10, a gigantic vehicle intended for delivery of man to the moon. About 25 years ago the gigantic rocket was checked out here, but its four launchings at Baykonur in 1969-1972 ended catastrophically.

In the TsNIIMash aerodynamics laboratory the journalists met up with still another unimplemented technical idea which nevertheless surprisingly clearly demonstrates the solution of those problems over which designers throughout the world will probably struggle for a long time. This is the second-generation Buran or a completely multiply reusable space transport system, which underwent aerodynamic tests in its time at the TsNIIMash (see figure). If the program had been carried out at the initially contemplated speed, the Buran ship so well known to us could have become the very first step on the path to a "shuttle" conquest of space. In this same laboratory tests were made of possible variants of the Energiya-2 booster. It was proposed that the booster be supplied with six accelerators instead of the four for the ordinary Energiya. Thus, it would be possible to increase the rocket payload put into a low circumterrestrial orbit to 150-200 tons.

Now the Energiya NPO designers have to move in the opposite direction: they are developing a reduced version of the Energiya rocket with two accelerators and a payload of 30 tons. In the coming year multisided testing of Energiya-M engines should take place on the launch pad- stand at Baykonur and if everything goes off in accordance with plan it will be ready for the first launching in 1995.

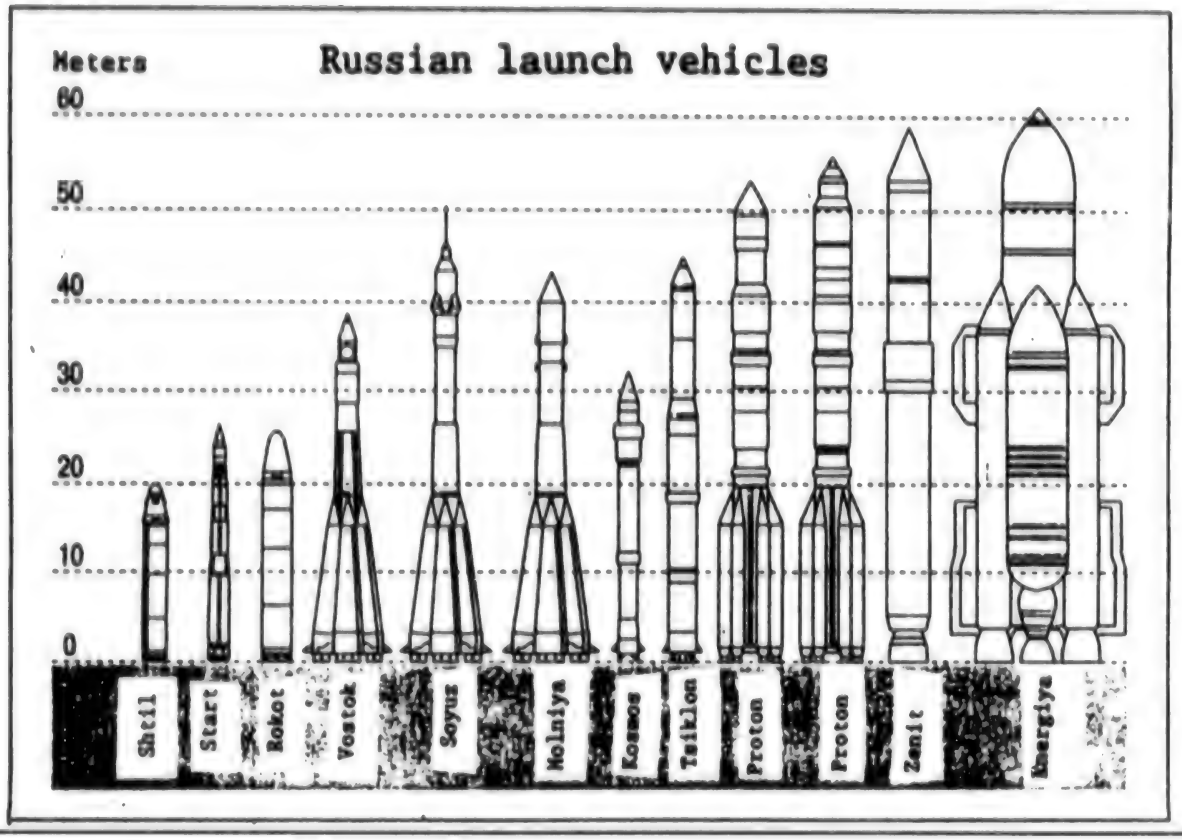
U.S. Policy, COCOM Restrictions Hindering Russian Access to Space Launch Market

937Q0115 Moscow KOMMERSANT DAILY in Russian No 63, 7 Apr 93 p 9

[Article by Mikhail Sergeyev, Sergey Morgachev, under the rubric "Russian in the Commercial Launch Market": "COCOM Restrictions Hinder Russian Firms"; first paragraph is source introduction]

[Text] **Russia has the world's largest capacity for producing launch vehicles and for performing commercial launches. But for now, only a few percent of that potential is being used, because Russian firms are cut off from the majority of foreign clients by the COCOM prohibitions on the entry of high-tech products into the CIS, including satellites. Experts, however, are inclined to think that those restrictions will, with time, weaken more and more, and the results of the meeting of the presidents of Russia and the United States that just took place provide new grounds for such a prediction. By the way, if Russian firms were to make their quota of 5-8 launches a year, which would be entirely feasible if the restrictions were weakened, that would enable them to earn nearly half a billion dollars a year.**

Commercial launch services that put satellites into near-Earth space are a business, and a rather large one by any standard. The world market for such services at present is estimated to be worth $1.5-1.8 billion a year. Russia remains the world's largest producer of rocket systems



suitable for commercial use, has the broadest range of such products, and has all the necessary infrastructure and know-how. It can perform as many as 40 launches a year, which constitutes more than half of the world's capacity and is twice the the current number of launches in the world. Russian rockets are known for their reliability (especially the Soyuz, the Kosmos, the Tsiklon, and the Proton). We would add that Russian firms are highly competitive in terms of prices, because they can make a profit at prices that are several times lower than the prices charged by Western competitors. It would seem that a broad field is opening up for business: "Load and launch." But, alas, at the moment, Russia is only a modest outsider in the space launch market.

Russia's Positions

In recent years, based on orders placed by foreign firms, Russian launch vehicles have been used for an average of one commercial launch every two years, which has made it possible to earn around $20 million. As for launches based on orders placed by Russian firms, the concept of a "commercial contract" has thus far been satisfied by only the launch last year by a Tsiklon rocket of two satellites of the Gonets communications system (the contract did not exceed several tens of millions of rubles).

In terms of projects in the negotiations stage, Russian firms in 1992 managed to conclude only two contracts with foreign clients. Judging from everything, another will soon be signed. Interestingly, in all three cases, on the Russian side are firms that were involved in the creation of the Proton rocket—the Moscow-based Khrunichev Plant, and the Salyut Design Bureau. The agreement between the Khrunichev Plant and the Lockheed company (U.S.) calls for the American partner to search for clients interested in Proton launches of satellites. A preliminary contract for about $50 million signed by Khrunichev and the Motorola company (U.S.) anticipates the launch of communications satellites of the Iridium system over several years. Plans call for the finalization of a contract worth $36 million between Salyut and the Inmarsat consortium.

Undoubtedly, that represents progress. But compared with Russia's actual capabilities, those achievements are not so great. That's because domestic firms and organizations are still not ready for the commercial use of launches, and the demand on the part of foreign firms is being blocked by the United States, which, to do that, is using the COCOM restrictions on the import of high-tech products into the countries of the Eastern Bloc, restrictions that were born during the years of the rivalry between the superpowers. So Russia's competitiveness in the world space launch market will remain only a potential competitiveness until a key problem is solved—the problem of eliminating or softening the United States' noneconomic control of the market.

The U.S. Role

In order to launch a satellite from a Russian space launch facility, one must, of course, bring the satellite into Russia. In the meantime, in order to bring an American satellite or a satellite containing American components (9 out of 10 vehicles produced outside of the CIS fall into that category) into Russia, one needs a special license approved by several U.S. agencies. Not once has either the USSR or Russia ever received such a license, and our main clients have been Indian, Bulgarian, and Czechoslovakian departments and firms who presented for launch satellites made without the use of American technology. Thus, the United States has virtually created for itself the capability to distribute quotas in the commercial launch market for countries that do not belong to the traditional Western community.

Commercial Launch Vehicles

Name	Price of launch, in millions of dollars	Weight put into orbit 500 km in altitude	Head developer	Maximum rate of launches (per year)
Russia				
Soyuz	15-16	7 tons	Progress, Samara	20
Kosmos	6-8	1.5 tons	Polet, Omsk	25
Proton	40-60	21 tons	Salyut, Khrunichev Plant, Moscow	17
Tsiklon	6-8	4 ton	Yuzhmash, Dnepropetrovsk	20
Zenit	25-30	15 tons	Yuzhmash, Dnepropetrovsk	20
Energiya	80-100	100 tons	Energiya, Moscow	1-2
Start-1 (m)	4-6	0.5 ton	Moscow Institute of Thermal Systems	25
Rokot (d) (m)	7-11	2 tons	Salyut, Moscow	20
Vostok	10-15	4.5 tons	Progress, Samara	25
United States, Europe, China, Japan				
Ariane-4	60-110	6 tons	Arianespace	14
H-2	60-80	4 tons	Mitsubishi Heavy Industries, Japan	2-4
Titan	80-150	18 tons	Martin Marietta, U.S.	4
Atlas	60-120	6 tons	General Dynamics, U.S.	5
Delta	60-100	3.5 tons	McDonnell Douglas, U.S.	5
Pegasus (m)	10-15	0.4 ton	Orbital Sciences, U.S.	20
Long March	25-30	5 tons	CGWIC, PRC	5-8

Note: d) - Project in development stage; m) - Booster that can be used in mobile variant.

Despite the efforts of the Russian Space Agency, Russian has still not received any kind of quota. The United States has preferred to drag the problem out, maintaining the possibility of examining each project on an individual basis and coming up with a solution that is best for it [the United States]. If an American company that wants to put a payload in space prefers to sign a contract with a Russian firm (because of the lower prices offered it, for example) and that contract does not lead to a clear loss of jobs in the United States, then the collaboration can, in theory, be allowed. In recent times, the attempts to remove the restrictions are being aided by the political considerations associated with "helping the reforms in Russia."

Assessing the Prospects

Russian firms are pinning some hopes on the possibility of bypassing the COCOM restrictions by using transportable (mobile) launchers. According to design, such mobile space launch facilities can be delivered to a potential client in any country, and the launch will be done without violating the COCOM requirements or U.S. law. There are designs of land-based mobile launchers (Start- 1, Moscow Institute of Thermal Systems), sea-based launchers (Okean, joint-stock company Kosmoflot), and air-based launchers (Burlak, Raduga Design Bureau; Aerokosmos, Machine Building Design Bureau [KBmashinostroyeniya], in Miass). True, those systems, based on military hardware, cannot be used for the more expensive launches of large satellites. Moreover, the system of agreements on the control of missile weaponry could be used to block the "voyages" of such systems.

The main thing, however, is not that the COCOM restrictions can be gotten around, but that they themselves, now an anachronism from a political standpoint, must, with time, be removed as the political and economic relations of Russia and the United States are regularized. The Russian Space Agency is officially declaring its desire initially to have a quota of two or three launches a year, which would

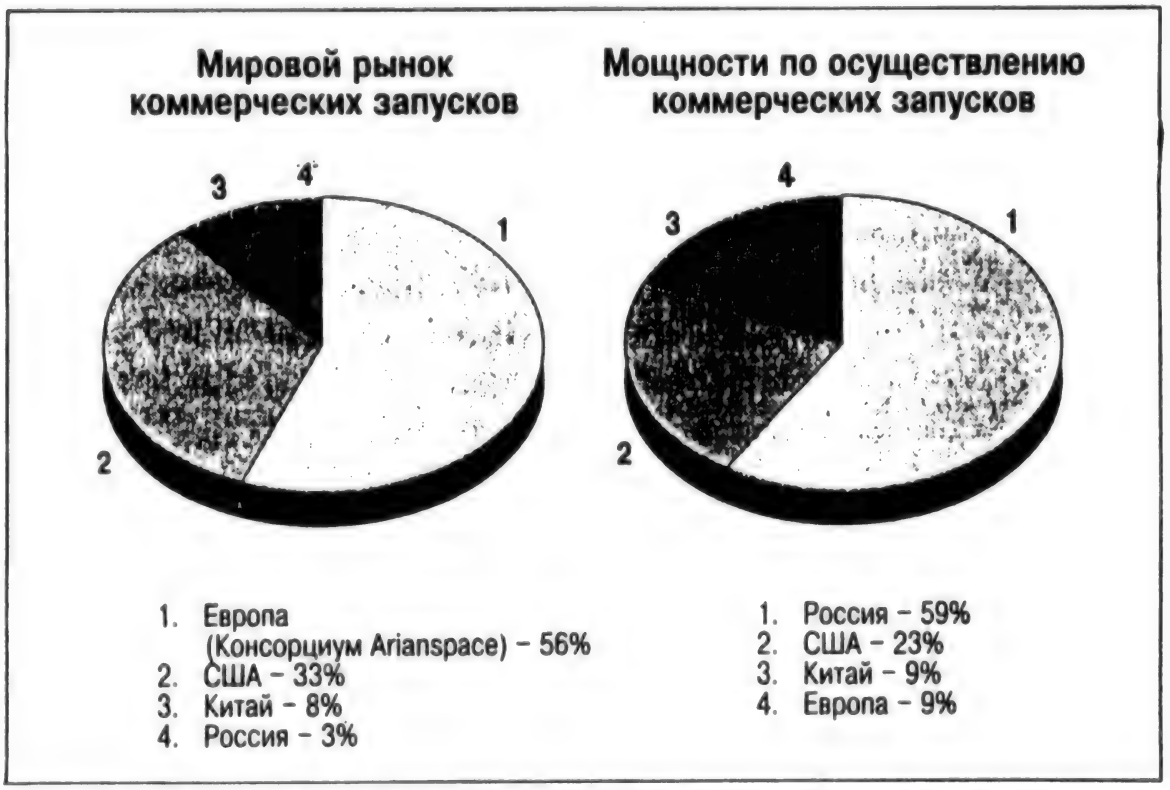
mean, on average, $200 million and would make it possible to recover the costs for the entire national civilian space program. A quota of 5-8 launches—which, assuming the favorable overall development of relations between Russia and the United States, could also easily become a reality—would mean movement to a sum of half a billion dollars, which would be considerable on the scale of the country. After the meeting that just took place between presidents Boris Yeltsin and Bill Clinton, during which the U.S. president voiced his intention of facilitating some softening of the restrictions on bringing American satellite technologies into Russia, the prospect of that has begun to look more feasible.

[Boxed item]

World Commercial Launch Market

The world commercial launch market, worth $1.5-1.8 billion, is divided among the European Consortium Arianespace, the American firms Martin Marietta, McDonnell Douglas, General Dynamics, China, and Russia (see the diagram). The market tends to grow 5-10 percent a year, so that it can double in 10 years.

Communications satellites are being put into orbit, as are weather satellites, Earth resources satellites, and satellites used for production experiments. The average launch price for one kilogram of payload is roughly $20,000. Depending on satellite weight, orbital altitude, and type of launch vehicle used, the unit cost of a launch ranges from $5 million to $100 million. Those prices can be considered excessive, because in the market at present is a situation in which demand exceeds supply. Which means that there are two- and three-year waits for the launch of payloads. The situation, however, is artificial to a large extent and is a result of Russian aerospace firms being squeezed out of the market.



World commercial launch market (left), capabilities to perform commercial launches (right)

Left: 1. Europe (Consortium Arianespace) - 56%; 2. U.S. - 33%; 3. China - 8%; 4. Russia - 3%. Right: 1. Russia - 59%; 2. U.S. - 23%; 3. China - 9%; 4. Europe - 9%.

Kosmoflot Official Discusses Commercial Activities, State of Buran Program

937Q0112A Moscow KOMSOMOLSKAYA PRAVDA in Russian 3 Apr 93 pp 1, 6

[Interview with Mikhail Ivanovich Osin, doctor of technical sciences and chairman of the advisory council of the joint-stock company Kosmoflot, by V. Karkavtsev: "The Space Program Doesn't Feed Us Anymore"; first paragraph is source introduction]

[Text] **The Buran developers today make less than a cleaning woman. Mikhail Osin doctor of technical sciences and chairman of the advisory council of the joint-stock company Kosmoflot, talks about the state of the space sector.**

[KOMSOMOLSKAYA PRAVDA] Mikhail Ivanovich, in a very short period of time, the space program in our consciousness has been transformed from the image of a princess to that of a suitcase without a handle. But people continue to work in the design bureaus, scientific research institutes, and space centers that grew out of Korolev's work. What's the state of mind like there?

[Osin] You know, I'm used to the exact sciences, so the state of mind about which you ask I'll translate into the language of figures. At Molniya, for example, an engineer makes 9,000 a month. Rubles. Does that say anything to you?

[KOMSOMOLSKAYA PRAVDA] It does. Literally yesterday, one young woman told me that she was invited to work as a reviewer at SP [not further expanded] with a starting salary of 50,000.

[Osin] What did you say to her?

[KOMSOMOLSKAYA PRAVDA] Trying to construe a look of indifference on my face, I wished her success in her new field.

[Osin] Well, in a similar manner, we've said good-bye to a third of our staff. I'm not going to say that they were all extratalented or, conversely, mediocre. There were geniuses, and mediocre people, and, simply put, just some guys with brains in their heads. But they all left for the same reason—the space program can't support them anymore. And they went to different places: to the "other side of the hill," or to commercial structures, or to the village—wherever their labor is valued.

[KOMSOMOLSKAYA PRAVDA] Forgive me, but what's keeping you, who part of the two-thirds who haven't "run away"?

[Osin] Let's not talk about me personally. Generally speaking, if I may be frank, I'm a candidate for the post of director of NPO Molniya, which became vacant after it was turned down by Gleb Yevgenyevich Lozino-Lozinskiy, the director of operations for the development of Buran. The elections will be on 8 April. And if I take part in them, it's not hard to guess that, regardless of the outcome of the elections, I don't intend to say good-bye to space technology.

But if we're talking about other people, the country today doesn't need specialists. Who is highly regarded? Politicians, bankers, stock brokers, macroeconomists. A dangerous trend has come about: Chatskiy has become more valuable in Russian than Levsha. But at some point the question will come up, Who among us can best deal with methylhydrazine (I'm just using it as an example)? And it will turn out that the most prominent specialist in that field will be working as an order-filler in Yeliseyevskiy.

[KOMSOMOLSKAYA PRAVDA] Your firm, and you personally, as far as I know, were directly involved in the development of Buran. What is going to happen to that superproject?

[Osin] Let's go back in time 10 years. Buran was being thought of as our answer to the American Shuttle. Remember those years—Ustinov, the pre-April chill. We were behind them by about seven years and couldn't duplicate the Shuttle. As a result, there appeared a more advanced system, a different system—Buran plus the Energiya launch vehicle.

My guys had to solve a local problem—the outside of Buran required thermal-protection tiles, and each model took 40,000 of them. We solved the problem, for which, by the way, we got the USSR Council of Ministers Prize, the last Ryzhkov prize.

Overall, the Energiya-Buran project cost 12 billion in what was still normal money. They gave us a condition: each launch (and that was 120-140 billion rubles [R]) had to make a profit. OK. We calculated that we could grow interferon on board, as well as insulin and crystals—the game was worth the candle. But then came the collapse, and money was devalued.

But people have to live. How? The Tushinskiy Plant, for example, where they assemble the Burans, threw out the lathes on which they made those thermal-protection tiles, and they replaced them with equipment for producing disposable syringes. They thought it would be a profitable business. But it wasn't: that market became instantly saturated. So in other spaces they decided to set up another income-producing line—the manufacture of bullet-proof vests. But there was a puncture there.

[KOMSOMOLSKAYA PRAVDA] It seems to me that that would be a going commodity.

[Osin] The market turned out to be oversaturated, and bullet-proof vests are sold freely in the Caucasus, and nobody would take them.

Finally, within the firm cooperatives began to be formed. One of them, by contract with the Ministry of Internal Affairs and the Ministry of Security, is creating a computer system for identifying individuals from the shape of their skull. Other work involves an order from AZLK [not further expanded] associated with the design of a new model of the Moskvich.

[KOMSOMOLSKAYA PRAVDA] But forgive me, all that has little to do with the space program. What's going to happen to Buran?

[Osin] Buran. Its second launch keeps getting moved. But you yourself can understand what state the plans are in if the lathe on which the thermal-protection tiles were made is out of commission, and the tile material is being used to make housings to bake porcelain teeth in.

As for other projects, Kosmoflot right now is developing several promising ideas. For example, the liftoff of a launcher from the sea.

[KOMSOMOLSKAYA PRAVDA] Just what kind of firm is Kosmoflot?

[Osin It's a joint-stock company created about a year ago. The hard reality of things forced a consolidation on a commercial basis of those involved in the space program. The founders of Kosmoflot, it seems, were all the most serious firms of our sector. The president of Kosmoflot is cosmonaut German Titov. And I'm the chairman of the advisory council. What's the objective of Kosmoflot? To find interesting projects, stir up interest in them among clients, get financing, and place orders.

How are things going? Let's take the idea already mentioned about the sea launch. Essentially, it's a fairly small cosmodrome in the ocean. Overall, there are 18 space launch facilities now on Earth. And in only two countries—ours and China—do the spent rocket parts fall on the country's own territory. What's the big deal about a sea launch? There aren't enough cosmodromes. But a lot of people want to put payloads in orbit. So we take a small "dish" about 40 meters in diameter out on pontoons to the open sea, we put a Rokot-type rocket on it, and, next thing you know, your two tons of payload are in orbit.

Another project involves the launch of the series-produced Shtal rocket from an ordinary airplane like the Ruslan or the IL-76. We have calculated that delivering a payload into low Earth orbit will cost a ludicrous amount of money: $2,000 per kilogram.

[KOMSOMOLSKAYA PRAVDA] But what are the prospects of that project in terms of demand?

[Osin] Understand that every self-respecting power has an interest in space. But building a space launch facility is an expensive luxury. So from the standpoint of demand, I think it's a very promising project. It costs a total of $80 million. As for dates, performing the first launch at the end of next year is entirely realistic.

[KOMSOMOLSKAYA PRAVDA] As I understand you, we're talking about Kosmoflot performing relatively cheap projects that will bring a fast return.

[Osin] Well, who needs expensive, long-term projects today? We have, for example, a program for the production of a lightweight transport aircraft. Right now, if I'm not mistaken, there are nearly 300 projects involving small aircraft in Russia. But air taxis like them are being developed by romantics—none of them has thought about demand. We want to build a small freight aircraft that will operated on diesel fuel and can land either on land or on water. It can be used as a medical transport, a patrol aircraft, a reconnaissance aircraft, and a freight transport. It'll be able to take up to two tons—load a Volga on it, if you like.

Yet another project involves windmills. A good many specialists are wracking their brains over them—in our country, in Germany, in the States. What could be easier—you erect that kind of mill and then whip up free energy from the wind. But that's not what has happened. First, it's a very materials-intensive thing, and as a result, the energy is not so free. On average, a kilowatt-hr costs 50 cents. The second catch is its short service life and the vibrations. In operating, such a windmill emits a very unpleasant, vibrating infrasound that is hazardous to human life. Birds, for example, don't get closer than a verst when they fly by. In America, the first windmill was serviced by prisoners, who raised a rebellion once. Sweden ran up against the protests of the "Greens" and was forced to drag coastal windmills into the sea.

I think we've managed to get around all those problems. We have a design developed with the help of the biggest cyclone specialist in the world, G. I. Kiknadze, who has made it possible to produce energy not at 50 cents per kilowatt-hour, but at 10 cents.

[KOMSOMOLSKAYA PRAVDA] I have to admit, Mikhail Nikolayevich, that I was quite surprised when I heard that in a firm like your NPO Molniya there were things like elections of the director. Of all sectors, all this plantwide democracy is absolutely uncharacteristic of the defense sector. But now I'm hearing from you about a labor council, a preelection campaign, a program of candidates.

[Osin] I understand: the general would speak, and the rest would salute. But the fact of the matter is that, before, the general didn't have any problems with orders or with financing. But now we're forced to take out loans at horrible interest rates in order to pay wages. And no matter which way we turn, we have to marry "virgin" space to "dirty" commerce. There's just no other way to survive.

What's more, we're seriously considering privatization. But not all at once—little by little. We can sell stocks only for specific projects—like the sea launch or the mini-aircraft. People can invest money in a project and then get dividends.

And maybe that's not be the worst thing that could happen, when people—even in such a closed or elitist realm like space—are beginning to think about how to adapt to the market. To raise your paws is the simplest of all. We're very anxious, for example, about you know what? The opening of a restaurant. Among all the other projects is this one—out of the compartments of Buran

that were meant for the dump, create a model of it, deliver it to Krasnopresnenskoye Naberezhnoye or to the shore of Khimkinsk Reservoir, outfit the inside with a restaurant, and serve foreigners there. Does Uncle Sam want to sit at the helm? Please do, because on the stand he can try his hand at taking off and at landing. Does he want to take home a piece of our military-space might? Please do, because they're cutting out a sheet from the skin of Buran and stamping a memorabilia medal out of it. We lead the guest around with a smile and invite him to drop by again. It's funny and paradoxical, but the future of the Russian space program rides on his visit.

Russia, Ukraine May Compete in Space Services Market

937Q0111A Moscow MOSKOVSKIYE NOVOSTI in Russian No 12, 21 Mar 93 p 8B

[Article by German Lomanov: "Ukraine and Russia May Be Competitors in Space Services Market"; first paragraph is source introduction]

[Text] **At the same time, they can hardly develop that sector without intimate cooperation. The only way they can get out of the impasse is with some big decisions.**

Addressing the parliament, the director of the Russian Space Agency, Yuriy Koptev, described the situation in the sector as extremely serious—last year, because of low wages (4,200 rubles [R] in science and R4,700 in production), nearly 30,000 scientists and designers left the space program, as did roughly 40,000 other employees. Speaking of the need for a serious reorganization of space science and industry, he named the development of communications systems as one of the top-priority areas.

Almost at the same time, the Ukrainian minister of machine building, the military-industrial complex, and conversion, Viktor Antonov, declared the same priorities. He noted that the Yuzhnyy Machine Building Plant, known for its SS-18 heavy-lift rockets, will, as before, manufacture the Tsiklon and Zenit launchers, which can lift into orbit satellites weighing 2.5 tons and 11 tons. But if a third, upper stage were to be created, it would be possible for them to place objects into geostationary orbit, too, which is very attractive for communications satellites.

Yuriy Koptev feels that the space industry can bring Russia $200-250 billion every year. Viktor Antonov didn't cite any specific figures, but said that, as a space power, Ukraine is prepared to fill orders from the countries of Europe, Asia, and America. Such optimism is hardly well-founded. It's no accident that, in fact, the only big contract in the space realm in the last few years has involved the delivery to India of cryogenic motors—a deal originated by the ministries of general machine building and internal affairs of the ex-USSR. Star Wars, thank God, is no longer a threat to us, but the trade wars in space are very fierce. Leading the space services market are the European consortium Arianespace, Americans operating in a NASA framework, and China, which has the Long March rocket and is offering launches at dumping prices or, at times, for free, in exchange for know-how.

Getting into the commercial launch market is very difficult. But now, two independent states of the CIS, trying to find a niche in a market long controlled by other countries, are becoming competitors. Such a situation, both for Russia and for Ukraine, only reduces chances for success that are not very good as it is. Especially when one realizes that the sector is sitting still, since commercial structures are still not very willing to invest money into capital-intensive space systems, and the parliaments (at least the Russian parliament) are just as unwilling to allot the scant budgetary appropriations.

It would seem that right now it's not competition that's more appropriate, but cooperation, a prototype of which could be that same Arianespace, which consolidates the efforts of 55 Western European firms and has managed to gain control of nearly 60 percent of the space services market. And then, of course, for such an association there is already a very well-equipped and expensive, if artificially broken-up, infrastructure—control centers, space launch facilities, tracking stations, and special communications channels.

Uzbek Space Agency Created

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[Article: "On the Launch Pad—'Uzbekkosmos'"]

[Text] The Uzbek State Agency for Space Research ("Uzbekkosmos") has been created by edict of President Islam Karimov.

For a long time that idea literally hung suspended in the air. One can recall that at one time the first person to propose it was the cosmonaut from our republic, People's Deputy of the Republic of Uzbekistan Major-General of Aviation Vladimir Dzhanibekov. And that is understandable, because in Tashkent and other cities in our republic there continue to operate top-secret scientific-research institutions, design bureaus, experimental production entities, and other projects that have a direct relationship to conquering the Universe. For example, the collective at the Tashkent KB [Design Bureau] of the former Minobshchemash [Ministry of General Machine Building] participated in the preparation and ground tests of various instruments and technology intended for studying the stars and planets, and, in particular, the moonwalker and Mars-walker.

After the collapse of the USSR and the proclaiming of the independence of Uzbekistan, those space companies remained without any centralized financing, and, consequently, without their basic work. Qualified specialists were on the point of losing their proficiency, and of leaving to join commercial structures or switching over to completely different production entities. For the sake

of objectivity I might note that the person who worried more than anyone else was Tashkent Academician Shavkat Vakhidov, who was previously involved in secret work, and who is the leader of the same KB. Together with a group of like-minded individuals, with the support of cosmonaut-deputy V. Dzhanibekov, Shavkat Akhadovich was able to deliver to the launch position the idea of organizing the "Uzbekkosmos" agency. Yes, all this was no simple thing to do. Opponents put up what seemed to be a valid argument: why should we worry about space, they asked, when the living conditions are difficult for our people? However, common sense won over. I am not afraid to state that it is with respect to the prospects for space research that one can learn about the farsightedness of the entire policy of any country.

The agency was formed. It seemed to everyone that the principal proponent of its idea would also head it. But Academician Sh. Vakhidov recommended for the position of general director a young, dynamic scientist in the field of nuclear physics, Candidate of Physical and Mathematical Sciences Kamol Muminov, who until recently headed the Tashkent NII [Scientific Research Institute] for the Construction of Space Instruments.

"We are now transferring to the welfare of the interests of science and the national economy of independent Uzbekistan our entire scientific-technical potential and infrastructure in the space branch," Kamo Musayevich states. "First of all it will be necessary to form, with a consideration of the long-term prospects, a state program and, in general, a policy in the area of research on the Universe, and to define the specific paths for its effective implementation under conditions of market relations. In the interests of developing the fundamental sciences, introducing the achievements of space technology and technological schemes into various branches of the economy and education, and into other spheres it is planned to broaden the boundaries of international cooperation with the nearby and distant foreign countries, and to restore the integration processes and put them on a qualitatively new basis. First of all, it is necessary to assume that we have in mind Russia, Ukraine, and Kazakhstan. Incidentally, the proximity of Uzbekistan to the Baikonur space center says a lot."

Thus, the program includes the resurrection, on a partnership basis, of the ties with all the space centers in what used to be the USSR, proceeding, of course, from the interests of the sovereignty of Uzbekistan. For example, a number of projects requiring long periods of construction in the mountainous zones of Dzhizak and Kashkadarya oblasts are being transferred to the agency's balance sheet. It is necessary to define what to do with them,, and how, on a mutually advantageous basis, to turn over those projects that are intended for the studying of the planets and the stars, and the tracking of artificial satellites and orbital stations. Possibly, these same projects will be suitable for teaching specialists and for training cosmonauts. Therefore the administrators of the young agency are beginning to develop commercial activity in the branch, to improve the instruction of personnel in the area of space technology, and to carry out joint research at orbital laboratories with the participation of representatives of the republic, or simply to lease for a definite period of time that same Mir [Peace] station in the interests of Uzbekistan.

Incidentally, this kind of experience has already been accumulated. During his five flights, our countryman V. Dzhanibekov, at the request of Tashkent scientists, carried out experiments with cotton seeds and with the radiation of crystals. In January 1993, silkworms went on board a Russian satellite. The experiment was prepared at the Uzbek Shelk [Silk] NPO [Scientific-Production Association] for the alluring goal of creating an artificial feed, which can cause a revolution in this branch of agriculture.

In a word, the agency's prospects are as limitless as the Universe itself.

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